draft

Study of the Draft Proposal of NPDES General Permit System Carpenter Creek Drainage Lewis and Clark National Forest

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Montana Bureau of Mines and Geology
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Earth Science Information

Contents

Appendixes

Plates

Figures

Tables

Introduction

This study was instituted in response to the proposed National Pollutant Discharge Elimination System (NPDES) forming a preliminary plan for a permit system for point source discharges from abandoned and inactive mining sites on Federal lands. This system was mandated by the Federal Water Pollution Control Act or 33 U.S.C. 1251 *et seq.* commonly referred to as the "Clean Water Act". This study was implemented to standardize a method by which abandoned mines could be prioritized to determine their impacts on a drainage. Ranking factors include: impacts within a watershed caused by mining operations, access and geology of the mining district, threatened and endangered (T&E) species within the watershed, watershed uses (drinking water supplies, wetlands, etc.), and the feasibility and impacts of clean-up efforts in a specific watershed.

To fulfill its obligations under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Northern Region of the United States Forest Service (USFS) has begun to identify and characterize the abandoned and inactive mines with environmental, health, and/or safety problems that are on or affecting National Forest System lands. The Northern Region of the USFS administers National Forest System lands in Montana and parts of Idaho and North Dakota. Concurrently, the Montana Bureau of Mines and Geology (MBMG) collects and distributes information about the geology, mineral resources, and ground water of Montana. Consequently, the USFS and the MBMG determined that an inventory and preliminary characterization of abandoned and inactive mines in Montana would be beneficial to both agencies, and entered into a series of participating agreements to accomplish this work. This study follows the work done for the USFS and the MBMG, incorporating the sampling data and the field inspections.

1.1 Project Objectives

A case study of a selected watershed was undertaken to define a system to identify and characterize abandoned and inactive mines on or affecting National Forest System lands in Montana. The objectives of this discovery process, as defined by the USFS, were to:

1. Utilize a formal, systematic program to identify the "Universe" of sites with possible human health, environmental, and/or safety-related problems that are either on or affecting National Forest System lands.

2. Identify the human health and environmental risks at each site based on site characterization factors, including screening-level soil and water data that has been taken and analyzed in accordance with EPA quality control procedures.

3. Based on site-characterization factors, including screening-level sample data where appropriate, identify those sites that are not affecting National Forest System lands, and can therefore be eliminated from further consideration.

4. Cooperate with other state and federal agencies, and integrate the Northern Region program with their programs.

5. Develop and maintain a data file of site information that will allow the region to pro-actively respond to governmental and public interest group concerns.

In addition to the USFS objectives outlined above, the MBMG objectives also included gathering new information on the economic geology and hydrogeology associated with these abandoned and inactive mines. Enacted by the Legislative Assembly of the State of Montana (Section 75-607, R.C.M., 1947, Amended), the scope and duties of the MBMG include, "...the collection, compilation, and publication of information on Montana's geology, mining, milling, and smelting operations, and ground-water resources; investigations of Montana geology emphasizing economic mineral resources and ground-water quality and quantity."

1.2 Abandoned and Inactive Mines Defined

For the purposes of this study, mines, mills, or other processing facilities related to mineral extraction and/or processing are defined as abandoned or inactive as follows:

A mine is considered abandoned if there are no identifiable owners or operators for the facilities, or if the facilities have reverted to federal ownership.

A mine is considered to be inactive if there is an identifiable owner or operator of the facility, but the facility is not currently operating and there are no approved authorizations or permits to operate.

1.3 Health and Environmental Problems at Mines

Abandoned and inactive mines may host a variety of safety, health, and environmental problems. These may include metals that contaminate ground water, surface water, and soils; airborne dust from abandoned tailings impoundments; sedimentation in surface waters from eroding mine and mill waste; unstable waste piles with the potential for catastrophic failure; and physical hazards associated with mine openings and dilapidated structures. Although all problems were examined at least visually (appendix I - Field Form), the hydrologic environment appears to be affected to the greatest extent. Therefore, this investigation focused most heavily on impacts to surface water near and ground water from the mines.

Metals are often transported from a mine by water (ground-water or surface-water runoff), either by being dissolved, suspended, or carried as part of the bedload. When sulfides are present, acid can form which in turn increases the metal solubility. This condition, known as acid mine drainage (AMD), is a significant source of metal releases at many of the mine sites in Montana.

1.3.1 Acid Mine Drainage

Trexler *et al.* (1975) identified six components that govern the formation of metal-laden acid mine waters. They are as follows:

1) availability of sulfides, especially pyrite,
2) presence of oxygen,
3) water in the atmosphere,
4) availability of leachable metals,
5) availability of water to transport the dissolved constituents, and
6) mine characteristics, which affect the other five elements.

Most geochemists would add to this list mineral availability, such as calcite, which can neutralize the acidity. These six components occur not only within the mines but can exist within mine dumps and mill-tailings piles making waste material sources of contamination as well.

Acid mine drainage is formed by the oxidation and dissolution of sulfides, particularly pyrite (FeS_2) and pyrrhotite ($Fe_{1-x}S$). Other sulfides play a minor role in acid generation. Oxidation of iron sulfides forms sulfuric acid (H_2SO_4), sulfate ($SO_4^{=}$), and reduced iron (Fe^{2+}). Mining of sulfide-bearing rock exposes the sulfide minerals to atmospheric oxygen and oxygen-bearing water. Consequently, the sulfide minerals are oxidized and acid mine waters are produced.

The rate limiting step of acid formation is the oxidation of the reduced iron. This oxidation rate can be greatly increased by iron-oxidizing bacteria (*Thiobacillus ferrooxidans*). The oxidized iron produced by biological activity is able to promote further oxidation and dissolution of pyrite, pyrrhotite, and marcasite (FeS_2 - a dimorph of pyrite).

Once formed, the acid can dissolve other sulfide minerals such as arsenopyrite (FeAsS), chalcopyrite ($CuFeS_2$), galena (PbS), tetrahedrite ($[CuFe]_{12}Sb_4S_{13}$), and sphalerite ([Zn,Fe]S) to produce high concentrations of copper, lead, zinc, and other metals. Aluminum can be leached by the dissolution of aluminosilicates common in soils and waste material found in southwestern Montana. The dissolution of any given metal is controlled by the solubility of that metal.

1.3.2 Solubility of Selected Metals

At a pH above 2.2, ferric hydroxide [$Fe(OH)_3$] precipitates to produce a brown-orange stain in surface waters and forms a similarly colored coating on rocks in affected streams. Other metals, such as copper, lead, cadmium, zinc, and aluminum, if present in the source rock, may co-precipitate or adsorb onto the ferric hydroxide (Stumm and Morgan, 1981). Alunite ($KAl_3[SO_4]_2[OH]_6$) and jarosite ($KFe_3[SO_4]_2[OH]_6$) will precipitate at pH less than 4, depending on $SO_4^{=}$ and K^+ activities (Lindsay, 1979). Once the acid conditions are present, the solubility of the metal governs its fate and transport:

1.4.1 Ranking of Watersheds

The tables from the 1998 Montana 303(d) list are included in plates 1a – 1d. These tables were used to determine which drainages were the most impacted by mining. Other factors that were used in the determination included: degree of impairment, proximity and concentration of mines, high value resources within the watershed, and likelihood that the watershed would be improved by remediation. A brief summary of these factors helps to rank the drainages in the chosen Federal land management area.

Belt Creek Watershed

Five of the six waterbodies within the Belt watershed have been impacted by mining and resource extraction. The only drainage in the Belt watershed not impacted was Otter Creek. Two main clusters of mines can be found in the Galena Creek/Dry Fork Belt Creek and along Carpenter Creek. The mines in these drainages exploited sulfide ore bodies with high base-metal content producing zinc, silver, lead, and gold. Host rocks varied in the Neihart district but included gneisses, porphyritic intrusives, and some Belt quartzites and shales. Minor carbonate minerals may provide some buffering but their percentage is not great.

The Snow Creek and Carpenter Creek mining complex (Facility ID number MT0001096353) are listed as a CERCLIS Superfund site (ID0801507) but is not listed on the National Priorities List (NPL). This area is defined as secs. 9, 10, 14-17, 20-23, 27-29, T14N, R08E. The site is also listed as a State Superfund site and ranked as "high" priority as of May 1996 on the MDEQ website. The Belt Creek CCC Camp, in Neihart, is listed as a State Superfund site but is ranked as "no further action". The Hughesville mining area is listed as "high" priority on the State Superfund list also. These mining complexes are the two high priority Superfund sites located within the Lewis and Clark National Forest boundaries.

No currently listed threatened or endangered species habitat occurs in the Carpenter Creek drainage. The upper reaches of the Carpenter Creek watershed are host to a genetically pure population of westslope cutthroat trout (*Oncorhynchus clarki lewisi*) which is not listed on the Endangered or Threatened Wildlife list but they have been proposed as Threatened and may become listed in the near future. This would make the Carpenter Creek drainage a critical habitat for this subspecies according to the Endangered Species Act of 1973. The genetically pure population has been isolated by the mining activity downstream which prevented hybridization with non-native trout. No other threatened or endangered species has been identified in the Carpenter Creek drainage. It is possible Canada lynx (*Lynx canadensis*) habitat, but this has not been confirmed (Steve Zachary, LCNF, 1998, oral commun.). The Canada lynx has been proposed as a threatened species.

Judith Watershed

The Judith River watershed contains predominantly small mines with very few adit discharges.

Most are accessible by two-wheel drive in good weather but no large population centers are nearby. The largest towns in the area are Lewistown, Stanford and Utica. According to the 1998 303(d) list, the Judith watershed is primarily impacted by agricultural practices and silviculture. No impacts from mining were noted in this list. The mines in Dry Wolf and Running Wolf creeks are small iron prospects hosted in limestone. The mines in Yogo Gulch and its tributaries are also small and are associated with limestone which may have a buffering effect on acid-rock drainage that may be produced.

Musselshell Watershed

The upper Musselshell watershed does not appear to have significant impacts from mining activity. The 1998 Montana 303(d) list states that waterbodies in the Musselshell watershed are primarily impacted by agriculture and silviculture. No impacts from mining were noted on the list. The mine sites are accessible by two-wheel drive in the summer months but no population centers are nearby. The towns of White Sulphur Springs and Martinsdale are closest; they are 18 miles and 17 miles away, respectively. Ninety-one mine sites were located in the Musselshell watershed using the MILS database. The majority of these were located in the Castle Mountain mining district. Within this district, most mines are located on private, patented land. This area has no CERCLA Superfund sites listed in it.

Smith Watershed

The Smith watershed contains 12 waterbodies listed on the 303(d) list, all of which are considered to be low priority for TMDL development. The 303(d) list claims that six of these waterbodies have some degree of impairment caused by placer mining and resource extraction. Placer mining may possibly impact siltation, and flow alteration. Placer mining does not have as great an impact as far as metals loading or pH alteration as lode mining would have. The Smith watershed has few metal mines and very few large population centers. Eleven mine sites were identified in the Smith watershed by using the MILS database. This is the fewest number of mines of all the watersheds associated with the Lewis and Clark National Forest.

MBMG staff and Robin Strathy, of the Lewis and Clark National Forest's Supervisor's office determined that the most useful and appropriate drainage would be that of Belt Creek in the Upper Missouri region of the Montana DEQ - watershed management section. Within this drainage, Carpenter Creek watershed was chosen as a case study for this report. Carpenter Creek is an unnumbered stream reach with the upstream reach number on Belt Creek (0260000) and the downstream reach number on Belt Creek (0240100).

Because this study concentrated on the effects of mining on watersheds, it was determined that the Dry Fork Belt Creek, Galena Creek and Carpenter Creek drainages were the most affected by mining within the Belt Creek watershed. Of these three drainages, the study area was further restricted to the Carpenter Creek drainage because it had the most impacts from mining and the largest number of factors to be influenced by the mining.

1.4.2 Data Sources

The MBMG began this inventory effort by completing a literature search for all known mines in Montana. To pare down this list to include only public lands, the MBMG plotted the published location(s) of the mines on U.S. Geological Survey 7.5-minute topographic maps and on copies of U.S. Forest Service ownership maps by hand. This was done in order to develop a list of all known mines located on or that could affect National Forest System lands in Montana. It was necessary to plot all mines because ownership is usually not noted in the literature description. The following data sources were used:

1) the MILS (mineral industry location system) data base (U.S. Bureau of Mines),
2) the MRDS (mineral resource data systems) data base (U.S. Geological Survey),
3) published compilations of mines and prospects data, primarily by the U.S. Bureau of Mines (USBM),
4) state publications on mineral deposits including consultants' reports to the state on previous abandoned mine studies such as Pioneer Technical Services reports to the Montana Department of State Lands - Abandoned Mine Reclamation Bureau (DSL-AMRB),
5) U.S. Geological Survey (USGS) publications on the general geology of some quads,
6) recent USGS/USBM mineral resource potential studies of proposed wilderness areas, and
7) MBMG mineral property files, theses and dissertations, and company reports.

During subsequent field visits, the MBMG located numerous mines and prospects for which no previous information existed. These sites were added to MBMG's Abandoned and Inactive mines (AIM) database. Conversely, other mines for which data existed could not be located in the field; these were kept in the database. Others were determined to be duplicate names for the same site; these were usually deleted from the database if they were exactly the same.

Initial work for this study also included obtaining a list of priority sites and principal mining districts of concern from the USFS staff involved in minerals and/or geology in their respective districts. Abandoned and inactive mine sites were plotted on 7.5-min. quadrangles. The mining districts were also identified by the Forest geologist or minerals specialist on the Forest Visitors Map for reference.

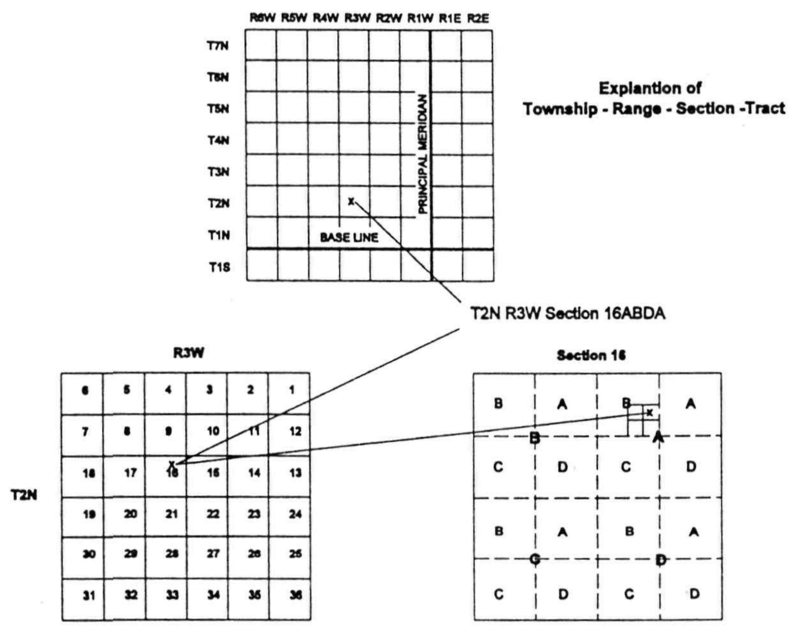
1.4.3 Pre-field Screening

Field crews visited only sites with the potential to release hazardous substances, and sites that did not have enough information to make that determination without a field visit. For problems to exist, a site must have a source of hazardous substances and a method of transport from the site. Most metal mines contain a source for hazardous substances, but the common transport mechanism, water, is not always present. Consequently, sites on dry ridgetops were assumed to be lacking this transport mechanism, while mines described in the literature as small prospects were considered to have inconsequential hazardous-materials sources; neither type was visited unless the geologist was coincidentally in the vicinity.

1.4.4 Ranking of Sites

Sites that could not be screened out as described above were visited. All visits were conducted in accordance with a Health and Safety Plan developed for the federal land management area. A MBMG geologist usually made the initial field visit and gathered information on environmental degradation, hazardous mine openings, presence of historical structures, and land ownership. Some site locations were refined or corrected using conventional field methods (marking the mine's location on a topographic map). Each site is located by latitude/longitude and by Township-Range-Section-Tract (figure 1 and table 6).

Figure 1. Explanation of tract, section, township, and range.



At sites for which sparse geologic or mining data existed, MBMG geologists characterized the geology, collected samples for geochemical analysis, evaluated the deposit, and described workings and processing facilities present. The sites were ranked by tiers with private sites screened out, dry sites that were unlikely to have environmental effects on Federal land ranked as "tier 1" and sites with potential impacts to Federal land ranked as "tier 2". Table 2 shows the MBMG identification number, the name of the site, the location and owner of the site, and the ranking. Private sites were ranked for the MDSL-AMRB by Pioneer Technical Services and their rankings are included for reference. The MDSL-AMRB's abandoned and inactive mines scoring system (AIMSS) includes a complex formula considering water and air transport of contaminants and the nature of those contaminants. An explanation of the ranking system is found in the summary report (MDSL-AMRB, 1995).

Table 2. Summary of sites in the Carpenter Creek drainage.

MBMG ID	NAME	LAT	LONG	PROP TYPE	OWNER	TIER	AIMSS
CC002897	BENTON MINE / REBELLION /SPOKANE	46.9478	110.7	LODE	P		
CC002891	BIG BEN DEPOSITS	46.9653	110.7114	LODE	N	1	
CC002885	BIG SEVEN	46.9486	110.7042	LODE	P		4.45
CC008529	BIG SEVEN PROSPECT	46.9536	110.7103	LODE	N	1	
CC002729	BLACK DIAMOND	46.9556	110.7006	LODE/MILL	P		
CC002879	BLACKBIRD / BLACK BIRD / MAUD S.	46.9403	110.7217	LODE	P		
CC002123	BLIZZARD	46.9461	110.7131	LODE	U	1	
CC002237	BOSS MINE	46.9458	110.7364	LODE	U	1	
CC002591	BOSS MINE / ATLANTUS	46.9331	110.7222	LODE	U	1	
CC002249	BROADWATER = LIBERTY?	46.9344	110.7244	LODE	P		10.08
CC002585	BROKEN HILL	46.9339	110.7208	LODE	U	1	
CC002693	BULL OF THE WOODS MINE	46.9342	110.725	LODE	P		
CC008407	CARPENTER CREEK TAILINGS	46.9667	110.7169	MILL	M	2	131.24
CC002573	CHAMPION "B"	46.9456	110.7261	LODE	P		
CC002567	COMPROMISE CLAIM	46.9361	110.7344	LODE	P		1.05
CC002561	CONCENTRATED AND MONARCH	46.9425	110.7417	LODE	P		
CC002537	CORNUCOPIA MINE	46.9542	110.6914	LODE	P		
CC002531	COWBOY/ISABELLE	46.9683	110.7197	LODE	M	1	
CC002525	CUMBERLAND	46.9397	110.7361	LODE	P		
CC002837	DACOTAH MINE	46.9458	110.7233	LODE	P		22.34
CC002483	DAWN AND FOSTER	46.9814	110.705	LODE	P		
CC002795	DOUBLE X (XX)	46.9792	110.7089	LODE	P		
CC002513	EIGHTY EIGHT / 88 / EIGHTY-EIGHT	46.9575	110.7378	LODE	P		
CC008414	EMMA	46.9786	110.7011	LODE	P		
CC002555	EQUATOR MINE	46.9414	110.7375	LODE	P		
CC002543	FAIRPLAY MINE	46.9456	110.7194	LODE	P		2.76
CC002699	FLORENCE MINE	46.9417	110.7417	LODE	P		
CC002501	FRISCO	46.9472	110.7425	LODE	P		
CC002495	GALT-QUEEN	46.9389	110.7403	LODE	P		
CC002873	GRAHAM & HOLLOWBUSH / S & R	46.9247	110.7264	LODE	P		
CC002255	HARNER & DAVIS PROSPECT	46.9311	110.7156	LODE	U	1	
CC002867	HARTLEY	46.9381	110.7281	LODE	P		11.73
CC002855	HATCHET	46.9578	110.7319	LODE	P		
CC008507	HAYSTACK CREEK MINE	46.9717	110.7186	LODE	P		
CC008497	HAYSTACK IRON SPRING	46.975	110.7192	LODE	N	2	
CC002603	HEGENER GROUP / VILIPA	46.9753	110.7111	LODE	P		
CC002597	HIDDEN TREASURE	46.9353	110.7264	LODE	M	1	
CC002861	INGERSOLL	46.9431	110.7297	LODE	P		
CC002921	IXL / I.X.L. / EUREKA	46.9517	110.7283	LODE	P		
CC002111	JOHANNESBURG	46.9853	110.7694	LODE	P		
CC002117	LEROY (SEE ALSO JOHANNESBURG)	46.9853	110.7694	LODE	P		
CC008527	LEXINGTON #2	46.9594	110.7022	LODE	N	1	0.83
CC002717	LEXINGTON / UNION/ MOUNTAIN VIEW	46.9472	110.7097	LODE	P		
CC008494	LIZZIE	46.945	110.73	LODE	P		
CC002927	LONDON	46.9456	110.745	LODE	P		
CC002849	LUCKY STRIKE / COMMONWEALTH /	46.9483	110.7156	LODE	P		
CC008496	LUCY CREEK	46.9686	110.7256	LODE	P		
CC002939	MINUTE MAN - LAST HOPE - WESTGARD	46.9711	110.7019	LODE	M	1	
CC002843	MOGUL LODE MINE	46.9278	110.7389	LODE	P		
CC002723	MORNING STAR MINE	46.9442	110.7456	LODE/MILL	P		

MBMG ID	NAME	LAT	LONG	PROP TYPE	OWNER	TIER	AIMSS
CC002681	MOULTON GROUP/COMPROMISE	46.9394	110.7333	LODE	P		3.32
CC002951	MOUNTAIN CHIEF	46.9531	110.7375	LODE	P		
CC008410	NEIHART TAILINGS	46.9417	110.7444	MILL	P		40.07
CC002957	NEVADA	46.9428	110.7356	LODE	P		
CC002963	NEW ALICIA & NEW RODWELL CLAIMS	46.9856	110.6931	LODE	U	1	
CC002813	PEABODY	46.9414	110.7347	LODE	U	1	
CC002705	PONDEROSA MINE	46.9769	110.6942	LODE	U	1	
CC002819	QUEEN OF THE HILLS	46.9394	110.7386	LODE	P		40.68
CC002807	RIPPLE	46.9453	110.6978	LODE	P		1.14
CC002801	ROCHESTER AND UNITY	46.9403	110.7292	LODE	P		1.74
CC002297	RUTH MARY AND FITZPATRICK	46.9197	110.7233	LODE	P		
CC002777	SAVAGE	46.9789	110.6978	LODE	P		
CC002765	SHERMAN	46.9736	110.6997	LODE	P		0.15
CC002741	SILVER BELT	46.9442	110.7211	LODE	P		3.83
CC008412	SILVER DYKE MILL	46.9783	110.6986	MILL	P		29.19
CC002711	SILVER DYKE MINE	46.9833	110.6944	LODE	P		125.98
CC008411	SILVER DYKE TAILINGS	46.9756	110.6953	MILL	P		72.88
CC002453	SILVER HORN	46.9464	110.7103	LODE	P		
CC008495	SNOW CREEK MILL	46.9581	110.7181	MILL	N	2	
CC002735	SPOTTED HORSE	46.9428	110.6958	LODE	N	1	
CC002579	THORSON HOOVER CREEK	46.9861	110.6756	LODE	N	1	
CC008524	UNNAMED ADIT SEC 09/ T14N/R08E	46.936	110.7128	LODE	N	1	
CC008525	UNNAMED ADIT SEC 16/T14N/R08E	46.9783	110.7203	LODE	N	1	
CC008523	UNNAMED PROSPECTS SEC 09/14N/08E	46.9842	110.7094	LODE	N	1	
CC002183	UNNAMED QUARRY	46.9086	110.6831	QUARRY	N	1	
CC002507	VENUS	46.9606	110.7142	LODE	U	1	
CC002747	WHIPPOORWILL MINE / BLOTTER CLAIM	46.9806	110.7056	LODE	M	1	

Sites with potential environmental problems were studied more extensively. The selection of these sites was made during the initial field visit using the previously developed screening criteria.

On public lands, sites with ground-water discharge, flowing surface water, or contaminated soils (as indicated by impacts on vegetation) were mapped by the geologist using a Brunton compass and tape. The maps show locations of the workings, dumps, tailings, surface water, geologic information, and sample locations.

1.4.4.1 Collection of Geologic Samples

The geologist took the following samples, as appropriate:

1) leach samples - selected composite samples for testing leachable metals (EPA Method 1312).

The sample was used to verify the availability of metals for leaching when exposed to water. Assay samples were only taken to provide some information on the types of metals present and a rough indication of their concentrations. Outcrops and mine waste were not sampled extensively enough to provide reliable estimates of tonnages, grades, or economic feasibility.

1.4.5 Field Methods

A MBMG hydrogeologist visited all of the sites that the geologist determined had the potential for environmental problems within the selected watershed. A hydrogeologist also visited the sites within the selected watershed that only had evidence of seasonal water discharges, possible sedimentation, airborne dust, mine hazards, or stability problems and determined if there was a potential for significant environmental problems. The hydrogeologist then determined whether sampling was warranted and if so, selected soil and water sampling locations.

1.4.5.1 Selection of Sample Sites

This project focused on the impact of mining on surface water, ground water, and soils. The reasoning behind this approach was that a mine disturbance may have high total metal concentrations yet may be releasing few metals into the surface water, ground water, or soil. Conversely, another disturbance could have lower total metal content but be releasing metals in concentrations that adversely impact the environment.

The hydrogeologist selected and marked water and/or soil sampling locations based on field parameters (SC, pH, Eh, etc.) and observations (erosion and staining of soils/streambeds) and, chose sample locations that would provide the best information on the relative impact of the site to surface water and soils. If possible, surface-water sample locations were chosen that were upstream, downstream, and at any discharge points associated with the site. Soil sample locations were selected in areas where waste material was obviously impacting natural material. In most cases where applicable, a composite-sample location across a soil/waste mixing area was selected. In addition, all sample sites were located so as to assess conditions on National Forest System lands; therefore, samples sites were located on National Forest System lands to the extent ownership boundaries were known.

Because monitoring wells were not installed as part of this investigation, the evaluations of impacts to ground water were limited to strategic sampling of surface water and soils. Background water-quality data are restricted to upstream surface water samples; background soil samples were not collected. Laboratory tests were used to determine the propensity of waste material to release metals and may lend additional insight to possible ground-water contamination at a site.

1.4.5.2 Collection of Water and Soil Samples

Sampling crews collected soil and water samples, and took field measurements (stream flow) in accordance with the following:

Sampling and Analysis Plan (SAP) - These plans are site specific, and they detail the type, location, and number of samples and field measurements to be taken.

Quality Assurance Project Plan (QAPP) (Metesh, 1992) - This plan guides the overall collection, transportation, storage, and analysis of samples, and the collection of field measurements.

MBMG Standard Field Operating Procedures (SOP) - The SOP specifies how field samples and measurements will be taken.

1.4.5.3 Marking and Labeling Sample Sites

Sample location stakes were placed as close as possible to the actual sample location and labeled with a sample identification number. The visiting hydrogeologist wrote a sampling and analysis plan (SAP) for each mine site or development area that was then approved by the USFS project manager. Each sample location was plotted on the site map or topographic map and described in the SAP; each sample site was given a unique seven-character identifier based on its location, sample type, interval, and relative concentration of dissolved constituents. The characters were defined as follows:

<u>DDA</u> <u>T</u> <u>L</u> <u>I</u> <u>C</u>

D: Drainage area - determined from topographic map
DA: Development area (dominant mine)
T: Sample type: <u>T</u> - Tailings, <u>W</u> - Waste Rock, <u>D</u> - Soil, <u>A</u> - Alluvium, <u>L</u> - Slag
<u>S</u> - Surface Water, <u>G</u> - Ground Water
L: Sample location (1-9)
I: Sample interval (default is 0)
C: Sample concentration (<u>H</u>igh, <u>M</u>edium, <u>L</u>ow) determined by the hydrogeologist, based on field parameters.

1.4.5.4 Existing Data

Data collected in previous investigations were neither qualified nor validated under this project. The quality-assurance managers and project hydrogeologists determined the usability of such data.

<u>1.4.6 Analytical Methods</u>

The MBMG Analytical Division performed the laboratory analyses and conformed, as applicable, to the following:

Contract Laboratory Statement of Work, Inorganic Analyses, Multi-media, Multi-concentration. March 1990, SOW 3/90, Document Number ILM02.0, U.S. EPA, Environmental Monitoring and Support Laboratory, Las Vegas, NV

Method 200.8 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - U.S. EPA

Method 200.7 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - U.S. EPA

If a contract laboratory procedure did not exist for a given analysis, the following method was used:

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, 3rd edition, U.S. EPA, Washington D.C.

EPA Method 1312 Acid-rain Simulation Leach Test Procedure - Physical/Chemical Methods, SW-846, 3rd edition, U.S. EPA, Washington D.C., Appendix G.

All analyses performed in the laboratory conformed to the MBMG Laboratory Analytical Protocol (LAP).

1.4.7 Standards

EPA and various state agencies have developed human health and environmental standards for various metals. To put the metal concentrations that were measured into some perspective, they were compared to these developed standards. However, it is understood that metal concentrations in mineralized areas may naturally exceed these standards.

1.4.7.1 Water-Quality Standards

The Safe Drinking Water Act (SDWA) directs EPA to develop standards for potable water. Some of these standards are mandatory (primary), and some are desired (secondary). The standards established under the SDWA are often referred to as primary and secondary maximum contaminant levels (MCLs). Similarly, the Clean Water Act (CWA) directs EPA to develop water-quality standards (acute and chronic) that will protect aquatic organisms. These standards may vary with water hardness and are often referred to as the Aquatic Life Standards. The primary and secondary MCLs along with the acute and chronic Aquatic Life Standards for selected metals are listed in table 2. In some state investigations, the standards are applied to samples collected as total-recoverable metals. Because total-recoverable-metals concentrations are difficult, if not impossible to reproduce, this investigation used dissolved metals concentrations.

1.4.7.2 Soil Standards

There are no federal standards for metal concentrations and other constituents in soils; acceptable limits for such are often based on human and/or environmental risk assessments for an area. Because no assessments of this kind have been done, concentrations of metals in soils were compared to the limits postulated by the U.S. EPA and the Montana Department of Health and Environmental Sciences (MDHES) for sites within the Clark Fork River basin in Montana. The proposed upper limit for lead in soils is 1,000 mg/kg to 2,000 mg/kg, and 80 to 100 mg/kg for arsenic in residential areas. The Clark Fork Superfund Background Levels (Harrington - MDHES, oral commun., 1993) are listed in table 3.

1.4.8 Analytical Results

The results of the sample analyses were used to estimate the nature and extent of potential impact to the environment and human health. Selected results for each site are presented in the discussion; a complete listing of water-quality, soil chemistry are presented in appendix III.

The data for this project were collated with existing data and incorporated into MBMG's abandoned - inactive mines data base. The data base is designed to be the most complete compilation available for information on the location, geology, production history, mine workings, references, hydrogeology, and environmental impact of each of Montana's mining properties.

Table 3. Water-quality standards.

	PRIMARY MCL(1) (mg/L)	SECONDARY MCL(2) (mg/L)	AQUATIC LIFE ACUTE(3,4) (mg/L)	AQUATIC LIFE CHRONIC(3,5) (mg/L)
Aluminum		0.05-0.2	0.75	0.087
Arsenic	0.05		0.36	0.19
Barium	2			
Cadmium	0.005		0.0039/0.0086(6)	0.0011/0.0020(6)
Chromium	0.1		1.7/3.1(6,7)	0.21/0.37(6,7)
Copper		1	0.018/0.034(6)	0.012/0.021(6)
Iron		0.3	1	
Lead	0.05		0.082/0.2(6)	0.0032/0.0077(6)
Manganese		0.05		

Mercury	0.002		0.0024	0.000012
Nickel	0.1		1.4/2.5[6]	0.16/0.28[6]
Silver		0.1	0.0041[8]	0.00012[8]
Zinc		5	0.12/0.21[6]	0.11/0.19[6]
Chloride		250		
Fluoride	4	2		
Nitrate	10(as N)			
Sulfate	500[9]	250		
Silica		250		
pH (Standard Units)		6.5 - 8.5		

(1) 40 CFR 141; revised through 8/3/93
(2) 40 CFR 143; revised through 7/1/91
(3) Priority Pollutants, EPA Region VIII, August 1990
(4) Maximum concentration not to be exceeded more than once every 3 years.
(5) 4-day average not to be exceeded more than once every 3 years.
(6) Hardness dependent. Values are calculated at 100 mg/L and 200 mg/L.
(7) Cr^{+3} species.
(8) Hardness dependent. Values are calculated at 100 mg/L.
(9) Proposed, secondary will be superseded.

Table 4. Clark Fork Superfund background levels (mg/kg) for soils.

Reference	As	Cd	Cu	Pb	Zn
U.S. Mean soil	6.7	0.73	24.0	20.0	58
Helena Valley Mean soil	16.5	0.24	16.3	11.5	46.9
Missoula Lake Bed Sediments	-	0.2	25.0	34.0	105
Blackfoot River	4.0	<0.1	13.0	-	-
Phytotoxic Concentration	100	100	100	1,000	500

Lewis and Clark National Forest

Approximately 1.8 million acres are administered by the U.S. Forest Service, Lewis and Clark National Forest (LCNF). The area lies east of the Continental Divide in west-central Montana (figure 2) and includes fragments divided into a northern "Rocky Mountain" division and a more southern "Jefferson" division. The regional office is located in Missoula, Montana, with the

Supervisor's office in Great Falls and district offices located in Choteau (Rocky Mountain), White Sulphur Springs (Kings Hill), Stanford (Judith), and Harlowton (Musselshell). The south half of the Great Falls 1° x 2°, a portion of the Cut Bank 1° x 2°, the area east of the Continental Divide on the Choteau 1° x 2°, the Roundup 1° x 2°, and the east half of the White Sulphur Springs 1° x 2° quadrangles cover the area. Lewis and Clark National Forest-administered land lies within portions of Meagher, Judith Basin, Pondera, Teton, Cascade, Fergus, and Lewis and Clark counties.

The topography is typical of southwestern Montana's front range province, grading from semiarid grass/sagebrush vegetated valleys to coniferous forests and alpine peaks above timberline. The Big Snowy, Highwood, Castle, Crazy, and Little Belt mountains lie within the Jefferson division of the LCNF. Typical elevations in the LCNF range from West Peak in the Big Snowy Mountains at 8,211 feet, the Little Belts' Neihart Baldy is 8,286 feet, Barker Mountain is 8,309 feet, and Yogo Peak is 8,801 feet. The highest peak in the Castle Mountains is Elk Peak at 8,566 feet. Valley elevations are about 5,000 feet.

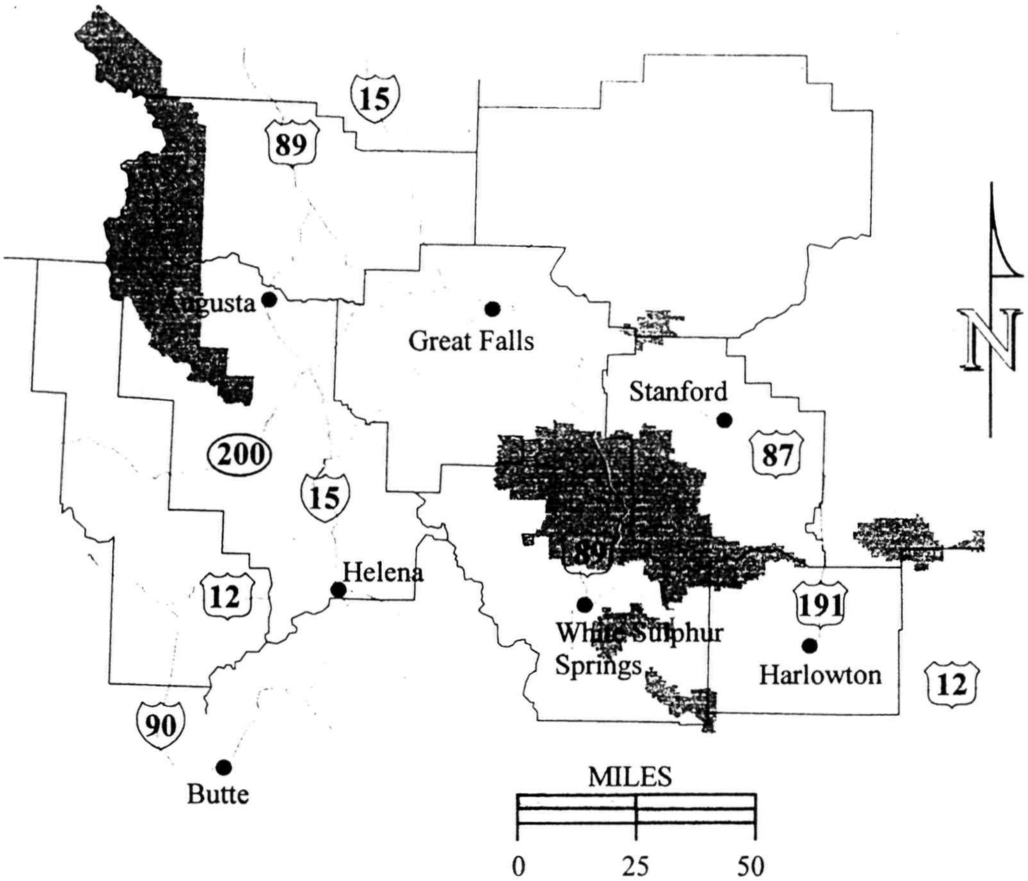
1.5 History of Mining

Some knowledge of the local mining history is helpful in understanding the problems created by the abandoned and inactive mines in the area. Silver in Barker and gold in Yogo Gulch were discovered in 1879, 15 years after many of the occurrences in Helena were first discovered (Schafer, 1935). Mining in Neihart was most active between 1882 and 1887. The Queen of the Hills claim, along with the Mountain Chief, Galt and Ball, were early mines. A railroad branch reaching the area in 1891 sparked renewed interest. The average silver price in 1890 was $1.05 per ounce and the price dropped to $0.99 in 1891, $0.87 in 1892, $0.78 in 1893, with a low of $0.52 in 1909. It did not begin a steady recovery until 1916 — a recovery that lasted until 1930 when the price crashed again. The area was idle again between 1930 and 1933. In 1933 there was renewed interest in the area. The Silver Dyke mine has consistently had the most active workings in the area since it was developed in 1921, with the Big Seven/Benton mines other major producers.

The Lewis and Clark National Forest includes all or part of more than six mining districts in three counties as defined by Hill (1912) and Sahinen (1935). These districts include: Cascade County - Montana (Neihart) (Ag, Au, Pb, Cu), and Sand Coolee (Fe); Meagher County - Castle Mountain (Pb, Ag, Cu), Musselshell (Copperopolis) (Cu, Au, Ag); Judith Basin County - Barker (Hughesville)(Pb, Ag) also partly in Cascade County, Yogo and Running Wolf (Au, Ag, Cu, Pb, Fe, sapphire). Robertson (1951) also included the Carbonate (Logging Creek) district in Cascade County (Pb, Zn, Au, Ag). Scattered mines occur elsewhere but not in organized mining districts.

1.5.1 Production

The total value of minerals produced from all mines within the Lewis and Clark National Forest boundaries was probably in the range of $32,000,000 with approximately $1 million from placers and the rest from lode mines. This figure was obtained by adding production figures from the



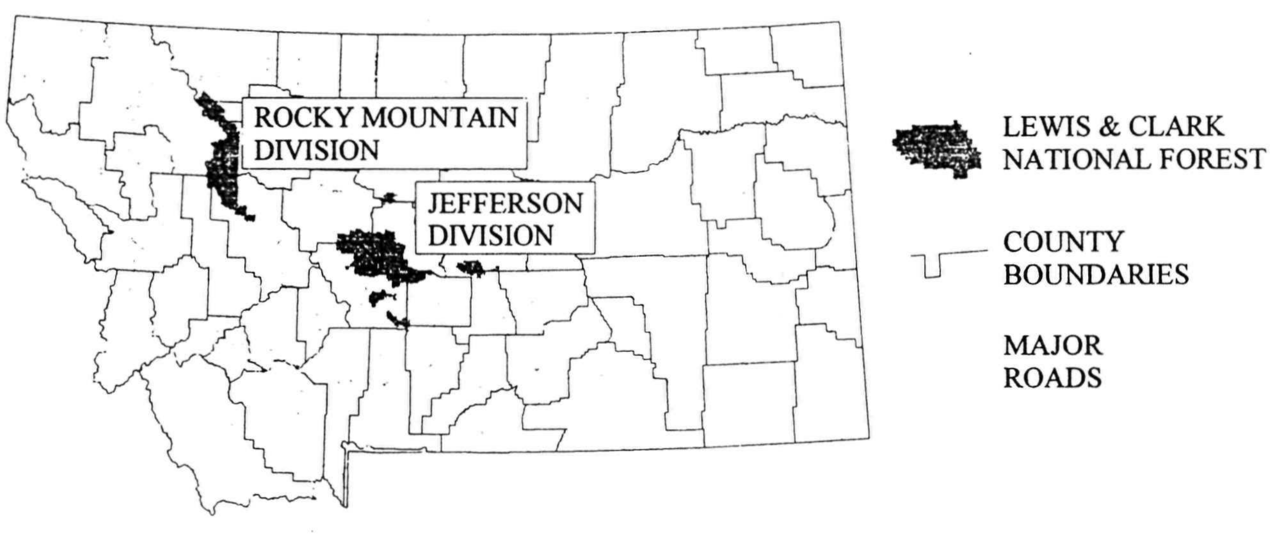


Figure 2. The Lewis & Clark National Forest and associated wilderness areas cover nearly 1.8 million acres in west-central Montana.

USBM reports mentioned previously. The estimated values reflect the price of commodities at the time of production and not current prices. A more current estimate at today's metal prices would total $86,275,000 but again this is a "ballpark" figure. This estimate does not account for metals mines since 1950 but this amount would be small in comparison to the production from pre-1950.

Table 5. Summary of production records by county.

County	Total Value	Gold (oz)	Silver (oz)	Copper (lb)	Lead (lb)	Zinc (lb)
Cascade 1889-1948	$20,093,595	35,312	15,697,412	7,882,328	65,523,298	15,156,496
Judith Basin 1921-1948*	$5,946,294	3,994	2,656,987	858,818	46,219,587	17,913,553
Meagher 1883-1947	$6,044,511	5,278	14,017	703,573	29,439,740	34,207

Production statistics from:
Robertson (1951) - Cascade County.
Robertson and Roby (1951) - Judith Basin County. *Production from 1889 to 1920 is combined with Cascade County (prior to Judith Basin County organization).
Roby (1950) - Meagher County.

1.5.2 Milling

An understanding of the history of milling developments is essential for interpreting mill sites, understanding tailings characteristics, and determining the potential for the presence of hazardous substances. Mills, usually adjacent to the mine, produce two materials: 1) a product that is either the commodity or a concentrate that is shipped off site to other facilities for further refinement, and 2) mill waste, which is called tailings.

In the 1800s, almost all mills treated ore by crushing and/or grinding to a fairly coarse size followed by concentration using gravity methods. Polymetallic sulfide-ores were concentrated and shipped to be smelted (usually to sites off USFS-administered land). Gold was often removed from free-milling ores at the mill by mercury amalgamation. Cyanidation arrived in the United States about 1891, and because it resulted in greater recovery rates, it revolutionized gold extraction in many districts. Like amalgamation, cyanidation also worked only on free-milling ores, but it required a finer particle size. About 1910, froth flotation became widely used to concentrate sulfide ores. This process required that the ore be ground and mixed with reagents to liberate the ore-bearing minerals from the barren rock.

Overall then, there were two fundamental processes used for ore concentration: gravity and flotation, and three main processes used for commodity extraction: amalgamation, cyanidation, and smelting. Each combination of methods produced tailings of different size and composition, each used different chemicals in the process, and each was associated with a different geologic environment.

1.6 Abandoned Mining Operation Inventory

A total of 227 sites were initially identified in or near the Lewis and Clark National Forest (LCNF) by using the U.S. Bureau of Mines MILS data base as a basic reference. Other sources of information include Roby (1950), Robertson and Roby (1951), Robertson (1951), Garverich (1995), Dahy (1988), and Blumer (1969). Table 5 summarizes the process by which the final results were achieved in the Lewis and Clark National Forest inventory. These numbers are accurate to the extent that the data base is updated and will change reflecting current progress in data base entry.

Table 6. Summary of Lewis and Clark National Forest investigation.

Total number of abandoned/inactive mine sites in the LCNF that were:	
Field Form	
Located in the general area from MILS	227
Sites added, either from literature or field work	45
Sites deleted as duplicates or not considered (outside Forest)	44
Field Form (Screening Criteria)	
Screened out because sites not in Belt Creek drainage	177
Private	32
Visited - no effects to Federal land	10
Unable to locate or screened out	6
PART C - Field Form	
Sampled (Water and Soil)	3

An individual discussion of each of the sites referred to the hydrogeologists and sampled is included in this report. All 272 sites inventoried as possibly affecting LCNF-administered land are listed in appendix II of this volume.

1.7 Mining Districts and Drainage Basins

The Lewis and Clark National Forest includes more than six mining districts as defined by several authors: Hill (1912), Sahenin (1935), Roby (1950), Robertson (1951), and Robertson and Roby (1951). These boundaries are subject to interpretation, change, and often the same district is known by various names, as in the case of the Montana or Neihart district, or the Barker or Hughesville districts. Some mines are not located in traditional districts, so for the purposes of this study, all the mines studied have been organized by drainage basin. This is a convenient way to separate the National Forest into manageable areas for discussion of geology and hydrogeology; and perhaps more important, it is an aid to the assessment of cumulative environmental impacts on the drainage.

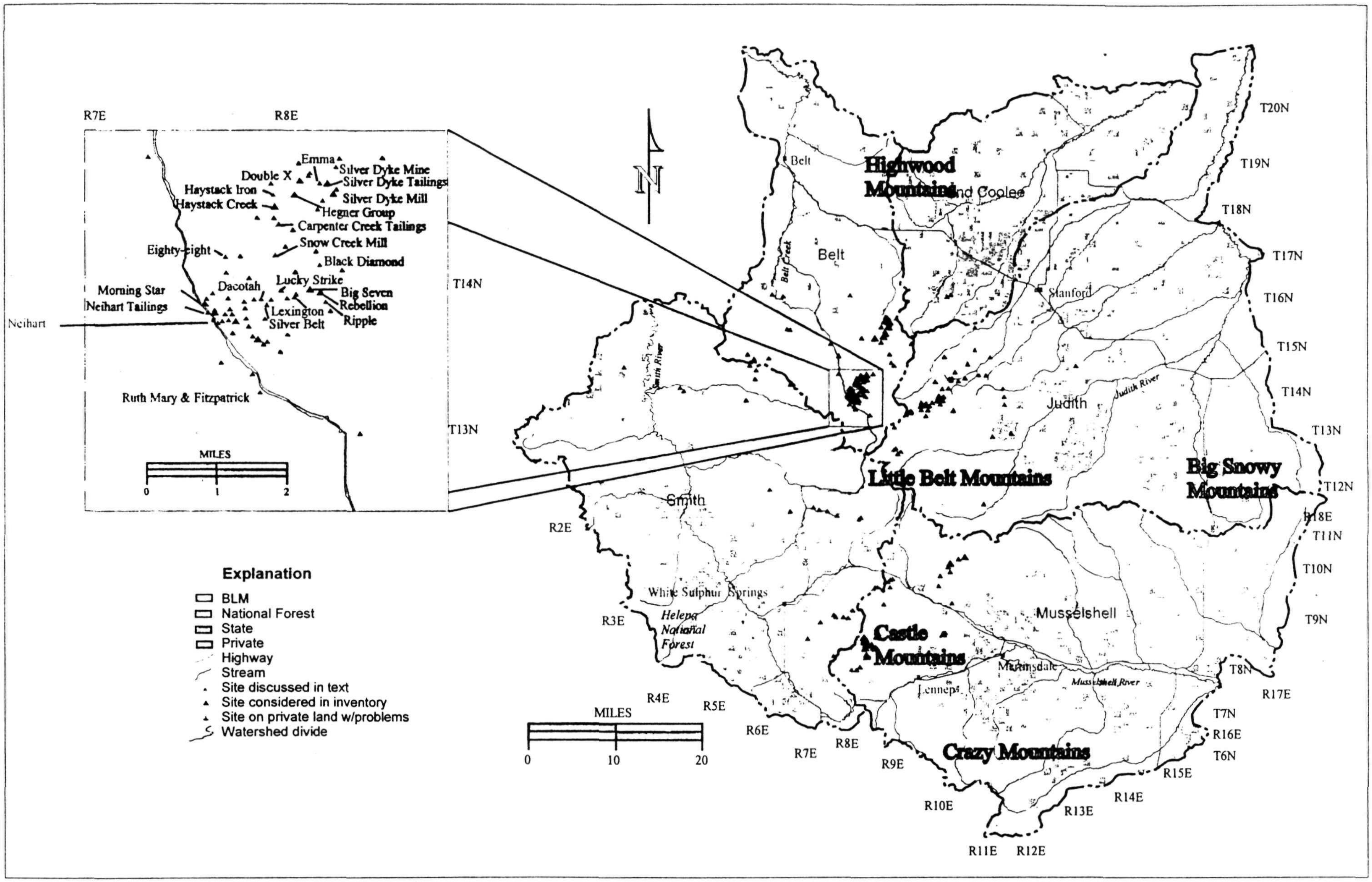


Figure 3. The Lewis and Clark National Forest contains several drainages, including the Musselshell, Judith, and Smith rivers as well as Belt Creek and Sand Coulee to the north.

Belt Creek, Musselshell and Judith River Drainages

The Smith, Musselshell, Sand Coolie Creek, Belt Creek, Teton, and Judith river drainages are in the Lewis and Clark National Forest, east of the Continental Divide (figure 3); all are in the Missouri River basin. These rivers all eventually join the Missouri River. A small portion of LCNF-administered lands drains to the Shields and Missouri (south of Canyon Ferry) rivers but no mines are located in these drainages. Major tributaries within the southern area of the Lewis and Clark National Forest include Belt Creek which flows north from the Hughesville and Neihart areas and joins the Missouri River north of Great Falls. The Smith River flows north-northwest and joins the Missouri River just south of Great Falls, as does Sand Coolie Creek. The Musselshell and Judith rivers drain the area to the east and also join the Missouri River.

2.1 Geology

The general area of the Lewis and Clark National Forest marks the east edge of the Belt Sea which deposited sediments in the trough known as the Helena embayment. Godlewski and Zieg (1984) show the general configuration of the margin of the Belt rocks (figure 4). Precambrian metamorphic basement rocks (gneisses and schists) as well as the Pinto diorite crop out in the Neihart area. The Belt-age Neihart quartzite unconformable lies on the older rocks. Laccoliths, dikes and sills have intruded the older rocks and are host to many of the ore deposits in the Neihart area. In the Barker and Hughesville area, Paleozoic rocks are preserved on the margins of broad domal uplifts (Robertson, 1951).

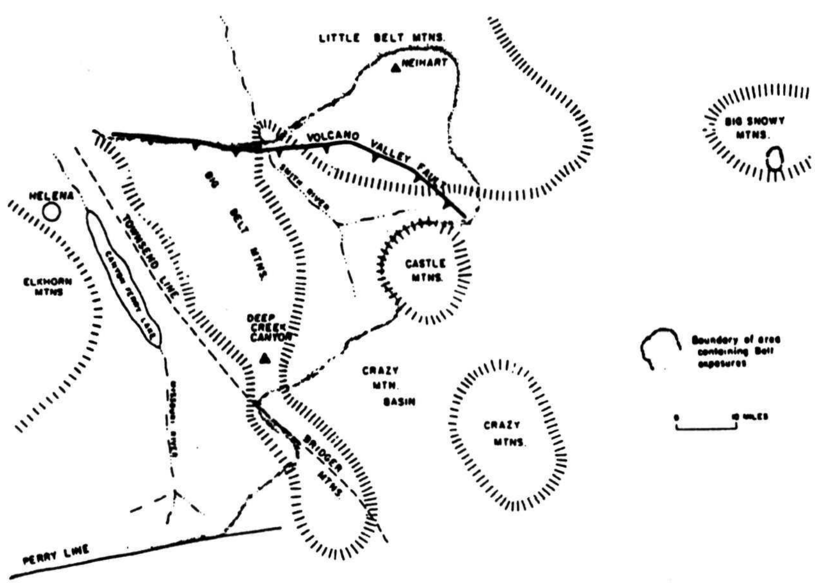


Figure 4. Limit of Precambrian rocks in the Helena embayment, from Godlewski and Zieg (1984).

2.2 Economic Geology

The portion of Lewis and Clark National Forest in the Jefferson division contains all or part of many mining districts: Castle Mountain, Neihart (Montana), Hughesville/Barker, Yogo/Running Wolf and Carbonate (Logging Creek) districts, with many small unnamed outliers in the other drainages (Sahinen, 1935). Figure 3 represents the mine sites and mill sites within the Lewis and Clark National Forest in the Belt Creek drainage.

Castle Mountain

The Castle Mountain district has been studied by many authors, including Weed (1896), Roby (1950), and Sahinen (1935). Sahinen (1935) lists the most productive period here as that before 1891. The Cumberland mine was the most productive in the district. The ore was found in dark brown siliceous jasper as replacement deposits associated with the Castle Mountain granite intrusive, the Robinson diorite, and limestone.

Neihart (Montana)

The lode mines near Neihart were discovered in 1882 (Sahinen, 1935) and total production to 1930, predominantly from silver, was estimated at $16,000,000. The deposits in this area occurred in veins in the gneisses and also in later dikes as disseminated occurrences. Sahinen divided the area into three types of deposits. The most productive mines were located Snow Creek drainage (including the Big Seven and Cornucopia) in fissure veins in gneiss, Pinto diorite and quartz porphyry and were high in gold content/low base metal content. The upper part of Carpenter Creek was characterized by low grade and high copper content, and deposits were found associated with dikes in the area. Mines characteristic of this area included the Silver Dyke and the Double X. The lowest area topographically included mines like the Broadwater and Moulton, and had higher base-metal concentrations with ore found in fissure veins in Pinto diorite and gneiss. Figure 5 shows the geology of the Neihart or Montana mining district.

Barker/Hughesville

The Hughesville/Barker mining districts are adjacent in the Galena Creek and Dry Fork Belt Creek drainages. The ore deposits are replacement (contact) deposits primarily hosted by Cambrian shales or Mississippian limestones where they are in contact with intrusives (Robertson, 1951). Lead, zinc and silver mineralization is hosted also in fissure veins related to the Hughesville quartz monzonite stock (Walker, 1991). These mines produced a total of $6,000,000 and were primarily active from 1879 to 1943 (Walker, 1991).

Yogo/Running Wolf

The Yogo and Running Wolf districts lie Judith Basin County. Yogo Gulch was the site of a small gold boom and later was the focus for many years of sapphire production. The metal mines are hosted by carbonate sedimentary rocks, primarily limestones, in contact with intrusives (Robertson and Roby, 1951). The sapphires of Yogo were mined both as placers and from a

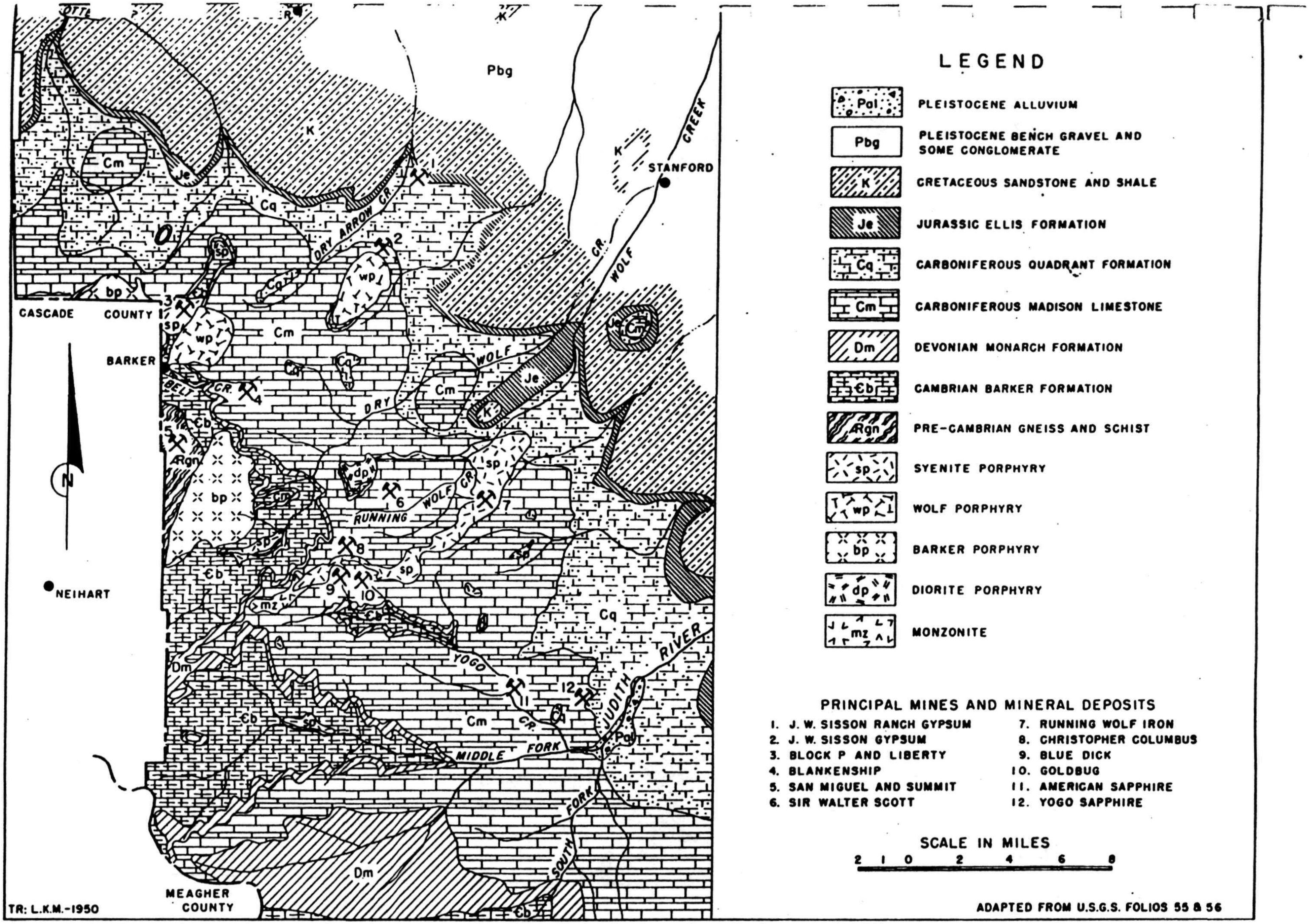


Figure 5. Geology of the Neihart mining district, showing the principal mines, from Robertson (1951).

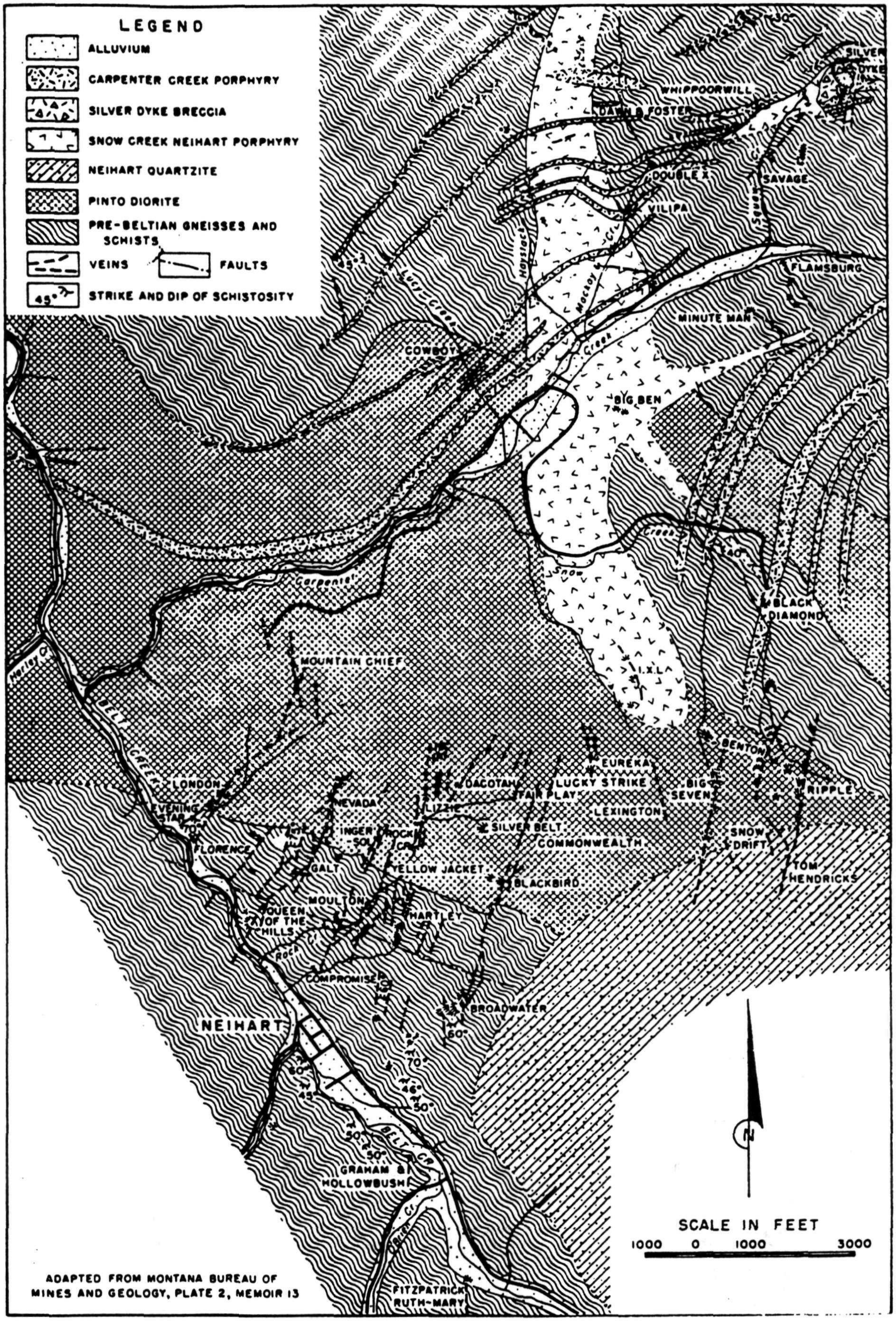


Figure 6. Geology of the Barker/Hughesville and Yogo mining districts, from Robertson and Roby (1951).

minette (biotite phenocrysts/alkali feldspar and biotite groundmass) or lamprophyre dike. The sapphires were recovered from the weathered rock by a washing process. The sapphire mines intermittently operated from the late-1890s to present day. Running Wolf district was known primarily for its iron deposits hosted by Madison limestone at contact zones. The limestone was intruded by a syenite porphyry, syenite or diorite porphyry intruded as dikes and sills (Robertson and Roby, 1951). The production from these districts is small with most coming before 1900 (Woodward, 1991) and approximately totaling 20,000 ounces of silver, 650,000 pounds of lead, 44,000 pounds of copper, 587 ounces of gold, and 700 pounds of zinc.

2.3 Hydrology and Hydrogeology

Average annual precipitation in the Belt Creek drainage ranges from 10 to14 inches in valleys to greater than 30 to 40 inches in the Little Belt Mountains (Bergantino, 1978). Average annual precipitation is 14.85 inches at White Sulphur Springs and 21.41 inches at Neihart (Western Regional Climate Center, 1998). Snowfall annually averages 132.8 inches at White Sulphur Springs with an average snow depth of 5 inches in January and 118.6 inches at Neihart with an average snow depth of 11 inches in January. July and August are listed as the only snow-free months. Temperatures in Neihart vary from an average low of 10.9°F during the winter to an average maximum temperature of 78°F during the July and August (Western Regional Climate Center, 1998).

The Belt Creek drainage descends southwestward from a little less than than 8,000 feet above sea level in the headwaters to 5,635 feet above sea level at Neihart to approximately 4,600 feet above sea level at Monarch.

The USGS currently maintains only one stream-flow gaging station within the Belt Creek and Dry Fork Belt Creek drainages. There is a discontinued gage called the Anaconda Drain at Belt, MT and an active water-stage recorder on Big Otter Creek near Belt, MT. The other closest active gaging stations are on the Missouri River up river or down river from where Belt Creek enters at Fort Benton and at Virgelle. These stations are too far removed from the study area to indicate any meaningful numbers in regards to drainage area.

2.4 Summary of the Carpenter Creek Drainage

There are 272 mine and mill sites on or near the Lewis and Clark National Forest within the considered drainages. Because of the limited nature of this study, mining districts and their mine sites were prioritized. The more likely districts to affect water quality were studied. Of these, three sites on Federal land along Carpenter Creek were determined to have a potential to have adverse effects on soil or water quality on LCNF-administered land. Of the three sites that have a potential of affecting LCNF-administered land, two sites have one or more discharges from workings or waste material and one site exhibited signs of water and wind erosion.

The Carpenter Creek drainage contains an isolated population of westslope cutthroat trout, believed to be a genetically pure strain isolated by the disturbances caused by mining activity downstream in the Carpenter Creek drainage (Robin Strathy, oral commun., 1998). This is the only high value resource located in the Carpenter Creek drainage.

The sites listed in **bold** exhibited one or more environmental problems and are discussed in the following sections. The mines in these drainages are presented generally upstream to downstream with the Neihart discussed first because it drains into the Missouri, the farthest upstream toward the headwaters.

Table 7. Summary of sites in the Belt Creek drainage (Neihart district and some adjacent mines).

NAME	ID #	VISIT	OWNER [2]	SAMPLE	HAZARD [4]	REMARK
Benton / Rebellion	CC002897	Y	PRV	N	NE	Significant AMD into creek.
Big Ben deposits	CC002891	Y	NF	N	NE	
Big Seven	CC002885	Y	PRV	Y	NE	DSL-AMRB report, streamside waste
Big Seven Prospect	CC008529	Y	NF	N	NE	Prospect only.
Black Diamond	CC002729	Y	PRV	N	NE	Private.
Black Bird	CC002879	Y	PRV	N	NE	Private.
Blizzard	CC002123	N	UNK	N	NE	Unable to locate.
Broken Hill	CC002585	N	UNK	N	NE	Unable to locate.
Carpenter Creek tailings	**CC008407**	**Y**	**MIX**	**Y**	**Y**	**Streamside tails - highly eroded and not vegetated.**
Cornucopia mine	CC002537	Y	PRV	N	NE	
Cowboy/Isabelle	CC002531	Y	MIX	N	NE	
Cumberland	CC002525	Y	PRV	N	NE	Surface prospects only.
Dacotah	CC002837	Y	PRV	Y	NE	DSL-AMRB report also.
Dawn & Foster	CC002483	Y	PRV	N	NE	
Double X (XX)	CC002795	Y	PRV	Y	NE	Discharging adit/ streamside waste.
Eighty-eight (88)	CC002513	Y	PRV	Y	NE	
Emma	CC008414	Y	PRV	N	NE	
Fairplay mine	CC002543	Y	PRV	N	NE	DSL-AMRB report.
Hatchet	CC002855	Y	PRV	N	NE	
Haystack Creek mine	CC008507	Y	PRV	Y	NE	Discharge - viewed from road.
Haystack Creek Iron Spring	**CC008497**	**Y**	**NF**	**Y**	**NE**	**Iron oxide precipitates; may be natural?**
Hegner Group - Vilipa	CC002603	Y	PRV	N	NE	DSL-AMRB report.
I.X.L. - Eureka	CC002921	N	PRV	N	NE	Screened out - dry ridgetop.
Leroy	CC002117	N	PRV	N	NE	Same as Johannesburg.
Lexington	CC002717	Y	PRV	N	NE	Discharge but sinks into ground. No acid.
Lizzie	CC008494	Y	PRV	N	NE	DSL-AMRB report.
Lucky Strike	CC002849	Y	PRV	N	NE	Discharge restricted to private land.
Lucy Creek	CC008496	Y	PRV	N	NE	
Minute Man-Last Hope	CC002939	Y	MIX	N	NE	
Mountain Chief	CC002951	Y	PRV	N	NE	
Neihart tailings	CC008410	Y	PRV	Y	NE	Streamside waste.
Nevada	CC002957	Y	PRV	N	NE	

New Alicia & New Rodwell	CC002963	N	UNK	N	NE	Screened out: dry ridgetop.
Peabody	CC002813	N	UNK	N	NE	Unable to locate.
Ponderosa	CC002705	N	UNK	N	NE	Unable to locate.
Ripple	CC002807	N	PRV	N	NE	Snow covered at time of visit.
Savage	CC002777	Y	PRV	N	NE	Vicinity of Silver Dyke mill.
Sherman	CC002765	Y	PRV	N	NE	DSL-AMRB reported discharge. No discharge observed at time of visit.
Silver Belt	CC002741	Y	PRV	Y	NE	AMD into Rock Creek.
Silver Dyke mill	CC008412	Y	PRV	N	NE	DSL-AMRB report
Silver Dyke mine	CC002711	Y	PRV	Y	NE	Discharge is source of Rock Creek.
Silver Dyke tailings	CC008411	Y	PRV	N	NE	Streamside waste - private.
Silver Horn	CC002453	N	PRV	N	NE	Screened out - inaccurate location. May be duplicate of Big Seven.
Snow Creek mill	**CC008495**	**Y**	**NF**	**N**	**Y**	**Hazardous structure, no effect to Snow Creek according to DSL-AMRB.**
Spotted Horse	CC002735	N	NF	N	NE	Screened out: ridgetop location.
Thorson Hoover Creek	CC002579	N	NF	N	NE	Screened out: commodity silica.
Unnamed adit - sec 9	CC008524	Y	NF	N	NE	Visited general area.
Unnamed adit - sec 16	CC008525	Y	NF	N	NE	Visited general area.
Unnamed prospect sec 9	CC008523	Y	NF	N	NE	Prospects only.
Venus	CC002507	N	UNK	N	NE	Unable to locate.
Whippoorwill /Blotter	CC002747	Y	MIX	N	NE	

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines).
2) Administration/Ownership Designation
   NF: LCNF-administered land
   PRV: Private
   MIX: Mixed (LCNF-administered land and private)
   UNK: Owner unknown
3) Solid and/or water samples (including leach samples)
4) Y: Physical and/or chemical safety hazards exist at the site.
   NE: Physical and chemical safety hazards were not evaluated.
5) Mill site present

The physical impacts of mining in the drainage are visually readily apparent while chemical and ecological impacts require sampling. The following narratives describe the relative impacts of each site as far as water quality and resource damage.

2.5 Haystack Iron Spring

2.5.1 Site location and Access

The mine site downstream is almost entirely on private, patented land but it was sampled to the north on LCNF-administered land. The spring is on LCNF-administered land. Access is via an improved gravel road to the downstream sample site and then by 4-wheel drive to the upper site.

The iron spring is in BDCC section 16 T14N R08E.

2.5.2 Site History - Geologic Features

Schafer (1935) described the geology around the Haystack Creek mine as a northeast-trending Carpenter Creek porphyry dike that cuts across the north-south contact of the Snow Creek Neihart porphyry and the "pre-Beltian" gneisses and schists. No other references to this mine was found in literature. No determination could be made if the spring was natural or if it was a result of a collapsed adit. No waste dump could be discerned and the water was emerging from a relatively flat spot (unlike where an adit would be driven). These two factors point to the source of the water being a natural spring.

2.5.3 Environmental Condition

The Haystack Creek drainage has not had as much development as some of the other sites in the Neihart mining district. Two adits are present–both are caved but one has an adit discharge (private land). The adit on private land discharges a bright orange flow with bright green algae. The flow enters Haystack Creek. The dumps have sphalerite and pyrite on them. The spring has not had a visible impact on the surrounding area, except for minor vegetative changes.

2.5.3.1 Site Features - Sample Locations

The site was sampled on 05/26/98. The downstream sample (BHCS20M) was taken approximately 15 feet upstream from the culvert on Forest Road 3323. The upstream sample (BHCS10M) was taken on LCNF-administered land in a small grassy meadow approximately 500 feet up the road from the adit. The Haystack Iron Spring occurs approximately 2,000 feet up from the turnoff from Forest Road 3323. Sample BHFS10H was taken directly from the spring as it emerged from the ground. This water does not flow on the surface into Haystack Creek. Site features and sample locations are shown in figure 9; photographs are shown in figures 9a and 9b.

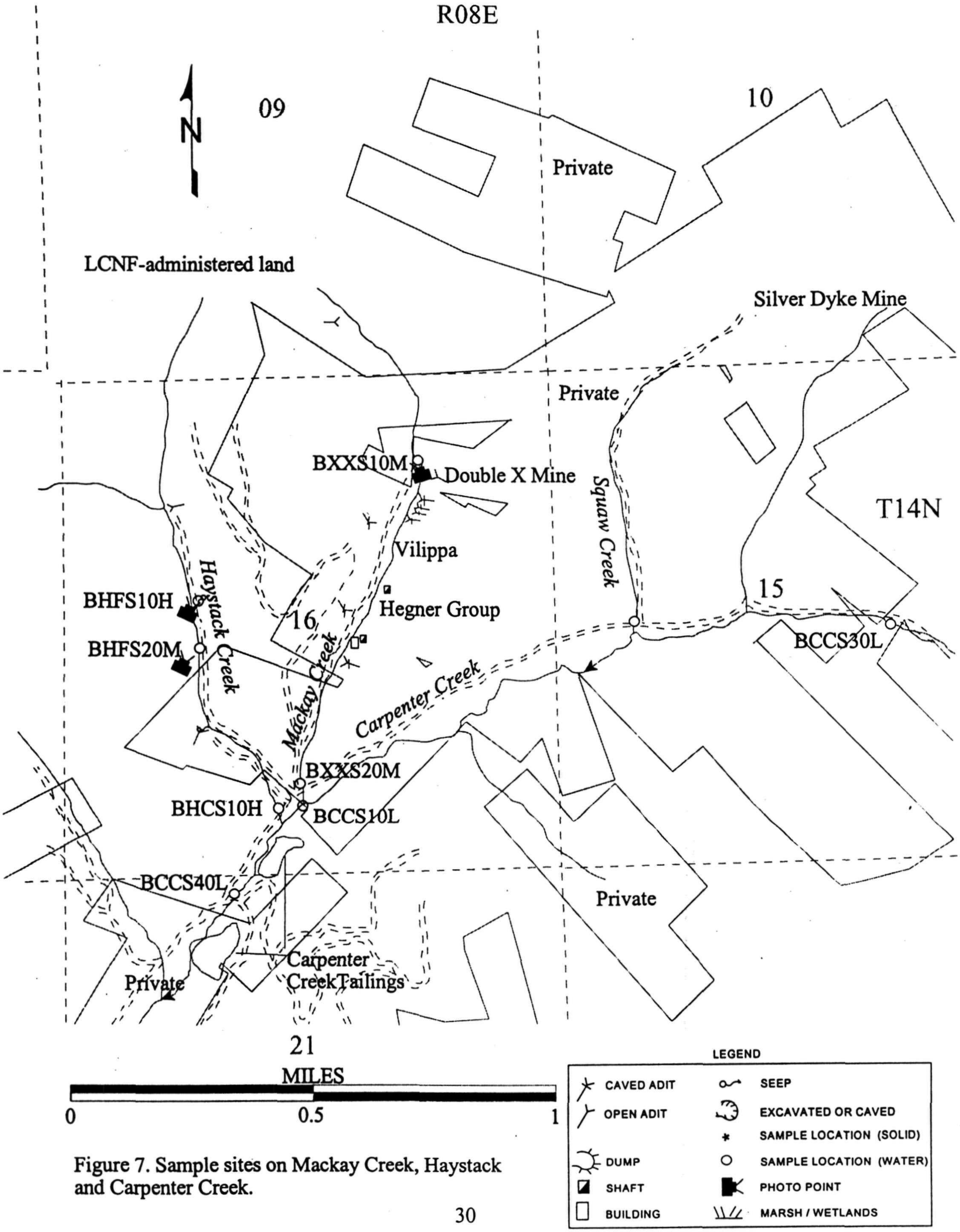


Figure 7. Sample sites on Mackay Creek, Haystack and Carpenter Creek.

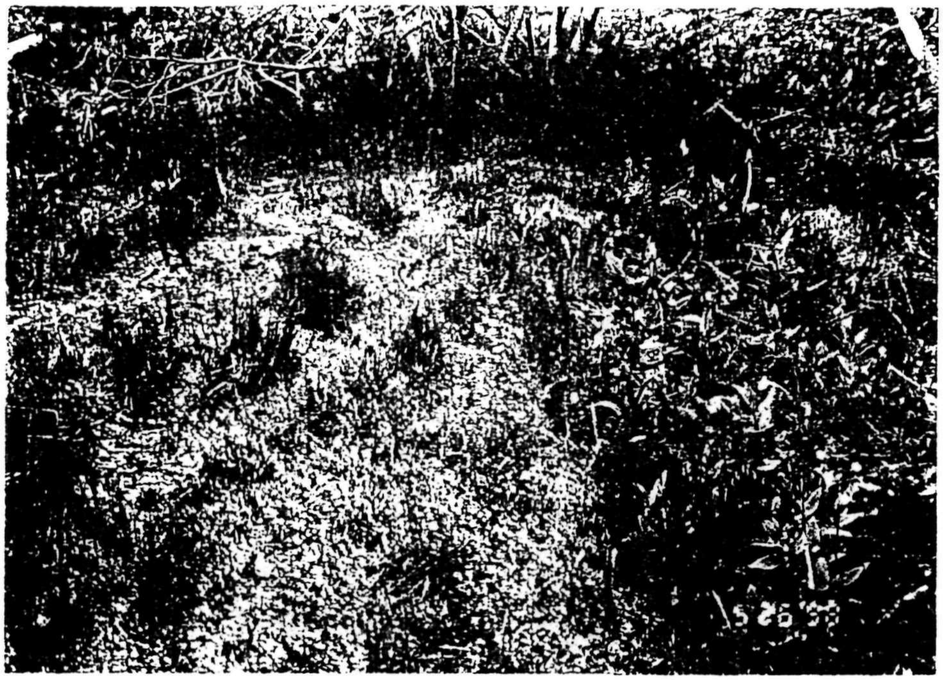


Figure 7a. The Haystack Creek Iron Spring discharged water (sample BHFS10H) that was brightly orange iron hydroxide stained but had abundant Equisetum growing in it.

Figure 7b. Haystack Creek looked clear and clean (sample BHCS20M) but slightly exceeded the secondary MCL, and aquatic and chronic life criteria for zinc.

2.5.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

2.5.3.3 Water

The water emerging from the Haystack Iron Spring is not as bad as it looks because of the iron staining. The only exceedence was in zinc which only exceeded the aquatic and chronic life criteria but did not exceed any MCL's. The pH was 6.86 and the SC was 903 μmhos. The flow was estimated at four gpm and it never reached the active drainage. The creek at its mouth also had a slight exceedence in zinc values but no water quality standards were exceeded in the upstream sample. The pH downstream and upstream were similar. The pH upstream was 6.88 and the SC was146 μmhos; the pH downstream was 6.78 and the SC was 139 μmhos. The TSS in the sample from the spring was higher than sample BHCS10M; it was 9.0 mg/l. The downstream sample on Haystack Creek measured 17.0 mg/l while the sample taken upstream of the mine measured <1.0 mg/l.

Table 8. Water-quality exceedences at the Haystack Creek mine and iron spring.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BHCS10M-upstream on Haystack Creek																			
BHFS10H-Haystack Creek Iron Spring													AC						
BHCS20M-downstream													AC						

Exceedence codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix III

2.5.3.4 Vegetation

The vegetation was not visibly affected on the banks of Haystack Creek. Lush grasses grew in the open meadow at the upstream sample site. Even at the iron spring, Equisetum grew in the water adjacent to the outflow.

2.5.3.5 Summary of Environmental Condition

The mines along Haystack Creek contribute metals to the creek, with zinc exceeding both aquatic and chronic water quality criteria. The Iron Spring may contribute a small amount to the total load but the water appears to never directly enter the creek on the surface.

2.5.4 Structures

No hazardous structures were noted on LCNF-administered land in this drainage.

2.5.5 Safety

No unsafe features were noted on LCNF-administered land. Safety concerns were not evaluated on private land. The adit on private land was collapsed.

2.6 Snow Creek Mill

2.6.1 Site location and Access

The Big Seven Group (private) mines (including the Benton and Ripple) are located in sections 28 and 29, T14N R08E. The Snow Creek millsite lies in CADA section 21, T14N R08E. downhill from the Snow Creek road. The road up Snow Creek follows the stream and is Forest Service access until the locked gate just past the switchback in section 22. It is approximately 1.6 miles from the turn off on Forest Road 3323 and the road to it passes through private land.

2.6.2 Site History - Geologic Features

The Big Seven was originally located in the 1880s and produced a large amount of silver and gold before 1898 (Schafer, 1935). Ore was mined out of four adits and the total amount of workings were in the range of greater than 8,000 feet. Siliceous ore predominated with some carbonates at the lower levels (Schafer, 1935). Ore minerals included pyrite, galena, sphalerite, proustite, and pearcite, with additional sulphides in small percentages (Schafer, 1935). The map in Schafer's report shows the Big Seven associated mainly with the Pinto diorite but the vein also cut gneisses and Snow Creek quartz porphyry along a well defined fissure.

Robertson (1951) estimated production at 143,274 tons of ore mined from 1902 to 1943. Approximately 17,538 ounces of gold, 2,306,353 ounces of silver, 63,022 pounds of copper, and 523,369 pounds of lead were produced during this time. According to Robertson, a 100-ton bulk flotation mill was initially used to process the ore but was replaced by a 150-ton selective flotation plant at the Big Seven. The mill on Snow Creek used a cyanide process.

2.6.3 Environmental Condition

The environmental condition of the Big Seven and associated mines was not directly addressed because it was on private land and not accessible. It is a fairly large site as viewed from the valley below with unvegetated, yellow waste dumps. Runoff during storm events erodes the waste and tailings, as noted in a previous visit to the area.

2.6.3.1 Site Features - Sample Locations

The upstream sample (BSNS10L) was taken at the switchback in sec. 22, T. 14 N., R 08 E. just below the locked gate. It was taken approximately 100 feet upstream of the culvert. The downstream sample (BSNS20M) was taken up stream from the mill and tailings on Snow Creek. Pioneer Technical Services (1995) dropped the Snow Creek millsite from their list of priority sites because they found the site did not impact the creek. The sample taken by MBMG therefore was taken up stream from the tailings to assess the effects of the mines upstream from the site. Site features and sample locations are shown in figure 10; photographs are shown in figures 10a and 10b.

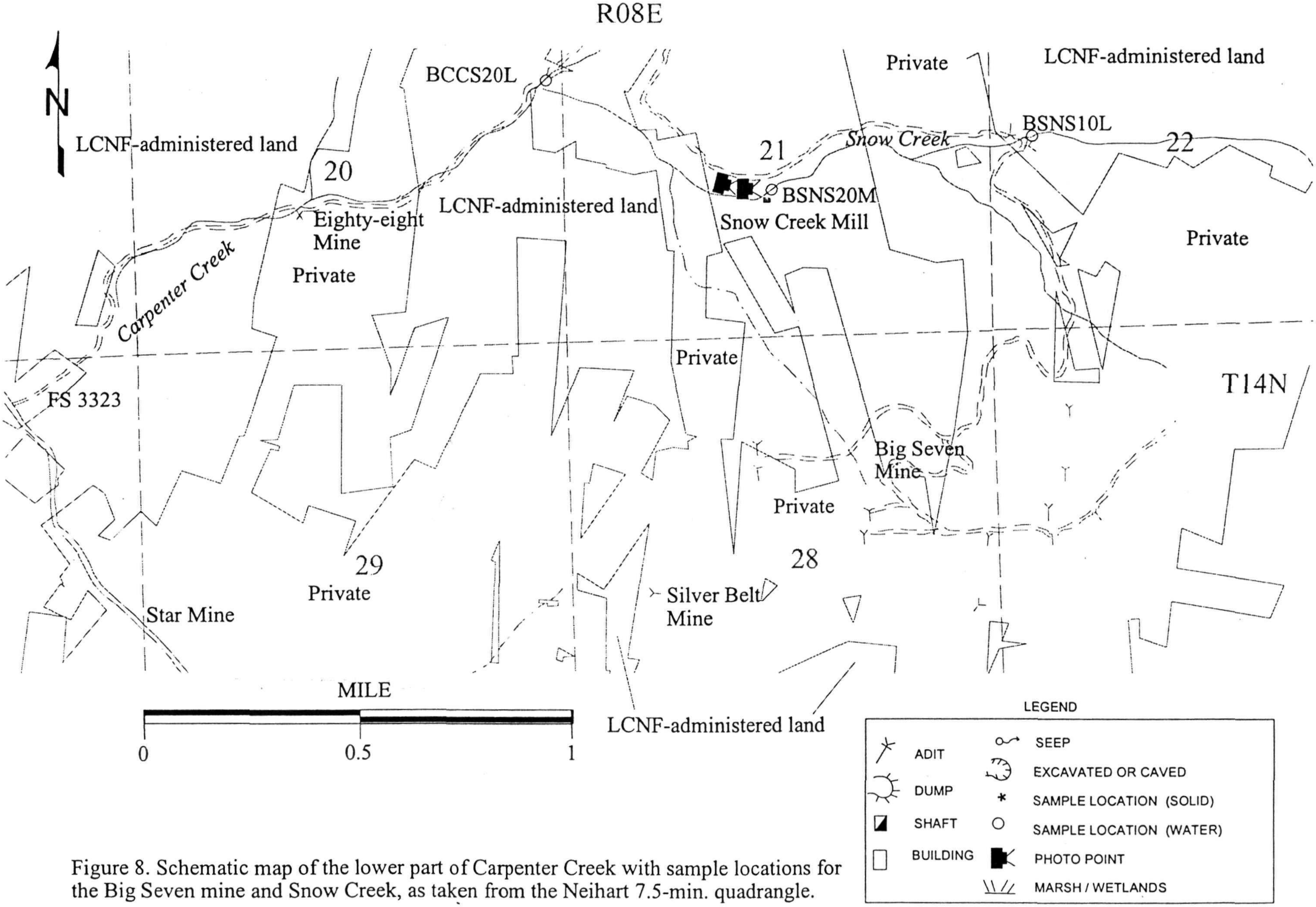


Figure 8. Schematic map of the lower part of Carpenter Creek with sample locations for the Big Seven mine and Snow Creek, as taken from the Neihart 7.5-min. quadrangle.

Figure 8a. Snow Creek was sampled upstream (BSNS20M) from the Snow Creek mill tailings. The bed of the creek was orange stained and had fine sediment which may be waste or tailings washed down from the Big Seven area.

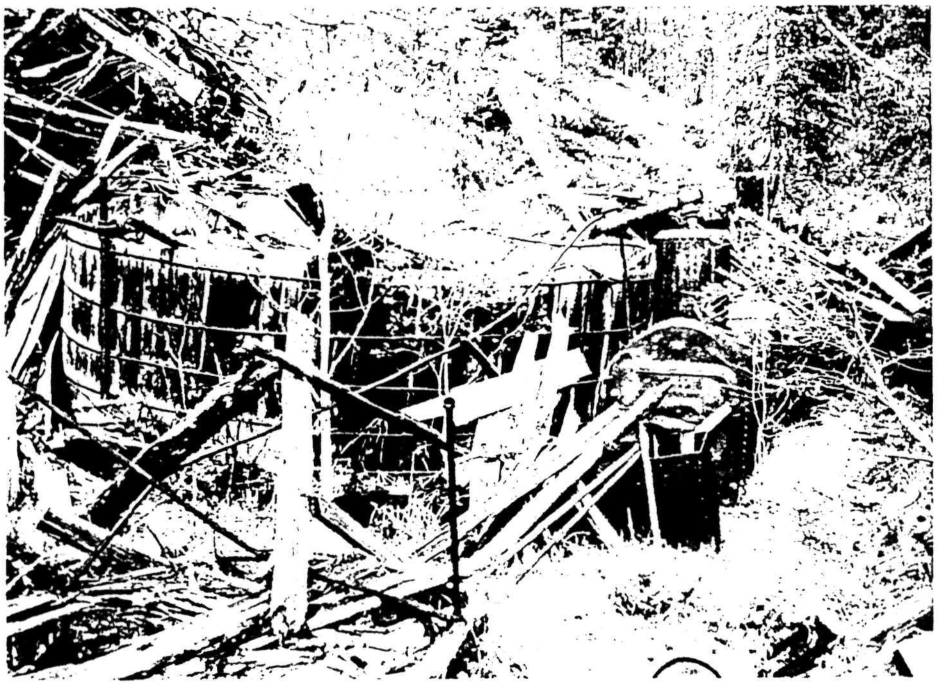


Figure 8b. The Snow Creek millsite bears remnants of its past including a vat with crushed ore and a boiler.

2.6.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

2.6.3.3 Water

The sample taken upstream from the Snow Creek millsite area revealed exceedences in cadmium (chronic aquatic life), manganese (secondary MCL) and zinc (acute and chronic aquatic life). The exceedences in this drainage are much lower than those at the Silver Dyke or at Rock Creek below, but zinc values were higher than those in Mackay or Haystack Creek. The pH in the creek was not significantly lower in the downstream sample in the field measurements but the lab pH decreased from 7.06 in the upstream sample to 6.80 in the downstream sample. The SC increased from approximately 50 μmhos upstream to about 150 to 170 μmhos downstream. No increase in the TSS level was noted; both upstream and downstream measured <1.0 mg/l.

Table 9. Water-quality exceedences – Snow Creek and below the Big Seven mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BSNS10L-upstream on Snow Creek																			
BSNS20M-downstream on Snow Creek				C					S				AC						

Exceedence codes:
- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix III

2.6.3.4 Vegetation

The vegetation along the creek does not appear visibly affected by the mining along the creek. The waste dumps at the Big Seven could be seen in the distance and were completely unvegetated.

2.6.3.5 Summary of Environmental Condition

The mines upstream on Snow Creek contribute metals to the creek, with cadmium exceeding chronic aquatic life standards and zinc exceeding both aquatic and chronic water quality criteria. Manganese exceeded the secondary MCL.

2.6.4 Structures

The millsite on Snow Creek was not quite totally collapsed and could be considered hazardous.

An outhouse perched on the banks of Snow Creek and a barn was still standing. Two or three other building were totally flattened. A wooden-stave tank or vat still contained crushed rock from the milling operations. Pioneer Technical Services sampled the contents; their stake with the sample numbers on it remain. The site received a safety score of 1.60 from the AMRB (DSL-AMRB, 1995).

2.6.5 Safety

The structures mentioned above could all be considered dangerous. Safety concerns were not evaluated on private land. Pioneer Technical Services (1995) noted two open adits and several buildings at the site.

2.7 Carpenter Creek Tailings

2.7.1 Site location and Access

The Carpenter Creek tailings are located approximately 2.15 miles from the Highway 89 turnoff up Forest Road 3323. They are very accessible and highly visible from the road. Two impoundments are present. The lower one, in CDDC section 21 T14N R08E, is entirely on private land and the upper one, in BACB section 16 is on LCNF-administered land.

2.7.2 Site History - Geologic Features

Very little is known about the history of these tailings. No mill building was found nearby. Schafer (1935) shows the two tailings ponds on his Plate 2 but he does not indicate where the mill was located. The Silver Dyke mine had a mill and a large amount of tailings are still present at the site. It has been stated that these impoundments were been built to hold the excess tailings from the Silver Dyke (Robin Strathy, oral commun., 1998). Judging from the size of the impoundments, they represent a large amount of production.

2.7.3 Environmental Condition

This area is striking in the amount of tailings present. The impoundments are sparsely vegetated and runoff channels are prominent. Carpenter Creek runs to adjacent to and, in places, through the tailings impoundment.

2.7.3.1 Site Features - Sample Locations

Three samples were taken to help characterize the site. An upstream sample (BCCS10L) was taken at the upper end of the tailings. A second sample (BCCS40L) was taken at the lower end of the impoundment on LCNF-administered land but upstream from the private site. A third sample (BCCS20L) was taken on Carpenter Creek downstream from the private tailings but upstream from where Snow Creek joins Carpenter Creek. Site features and sample locations are shown in figure 11; panorama photograph are shown in figure 11a.

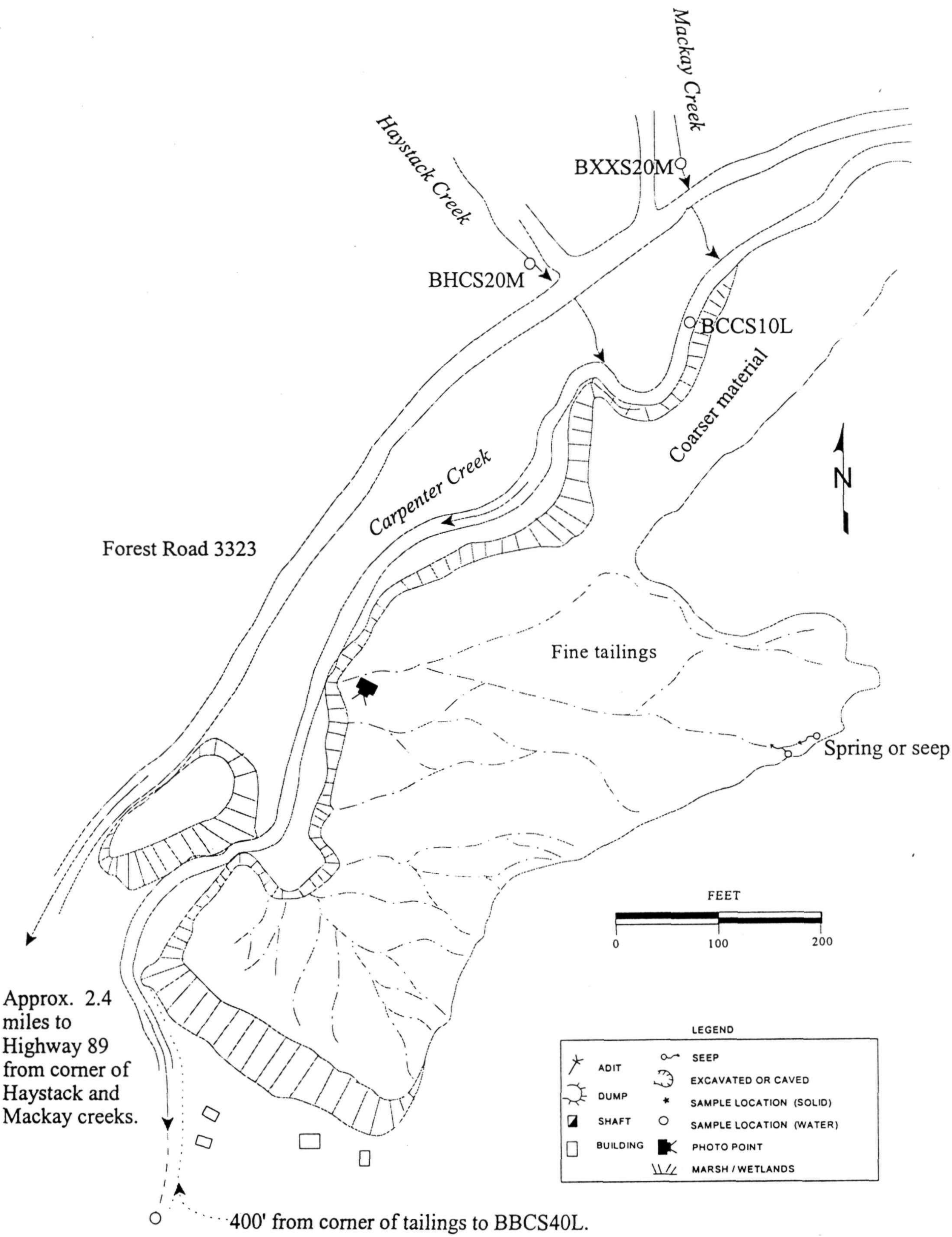


Figure 9. Rills and gullies mark intermittent erosional channels on the Carpenter Creek tailings, as mapped 5/27/98.

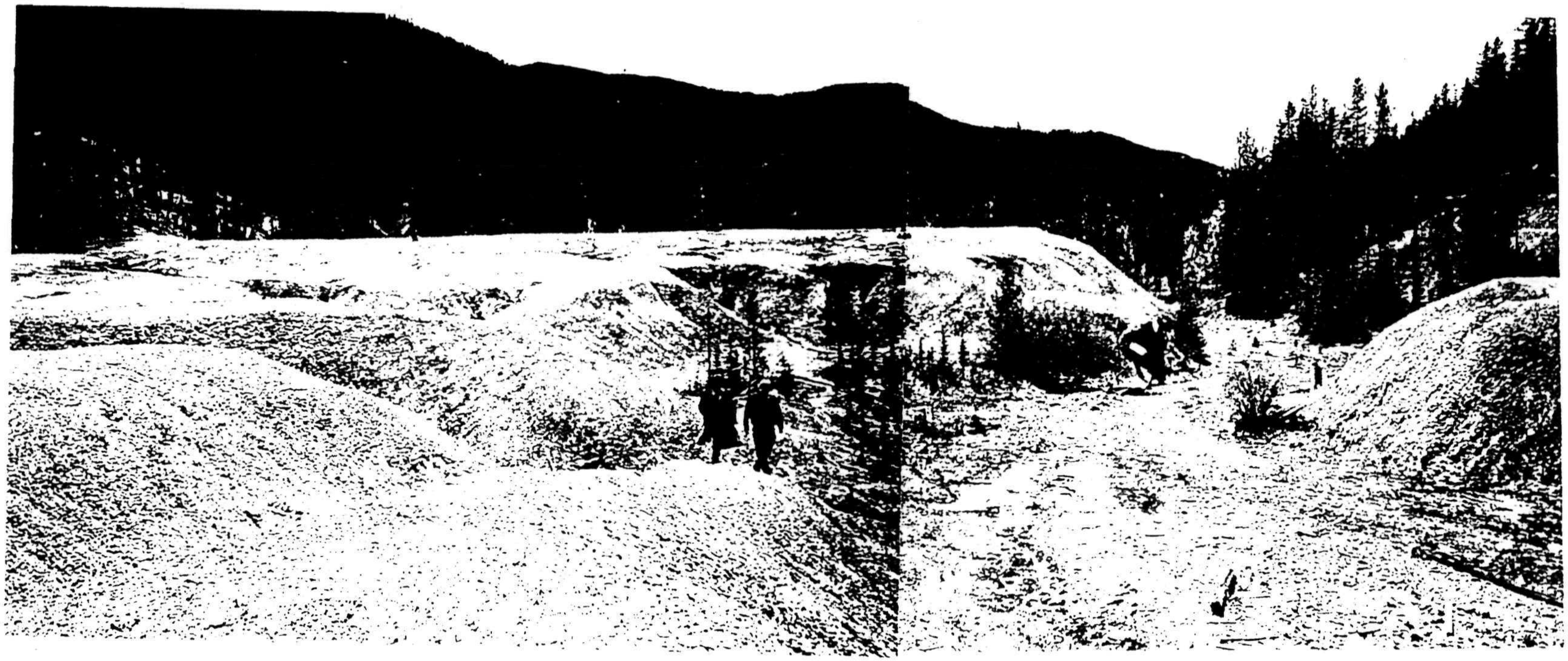


Figure 9a. Rills and gullies dissected the surface of the upper impoundment of the Carpenter Creek tailings reflecting the erosion of the tailings, as visited 05/27/98.

2.7.3.2 Soil

Soil samples were not taken because the tailings were in direct contact with the creek. Pioneer Technical Services analyzed the tailings in 1995. They found that the 111,000 cubic yards of tailings found in the two impoundments contained elevated levels of arsenic, cadmium, copper, lead, barium, cobalt, manganese and zinc. Approximately, one-half of the tailings are in the upper impoundment on Federal land. Pioneer also took sediment samples and found no exceedences of drinking-water standards. Their samples did exceed acute aquatic life criteria in cadmium, copper, lead and zinc; they exceeded chronic aquatic life criteria in mercury, cadmium, copper lead, and zinc.

2.7.3.3 Water

The water in Carpenter Creek did not appear exceedingly iron stained. No aquatic life was noted and very little plant life grew in the creek. The upstream sample reflected the influence of the mining farther up the drainage although the values had been diluted by the time the water got to the sample site. Immediately downstream of the upper tailings impoundment, cadmium had increased enough to exceed the chronic aquatic life standard; in addition, manganese exceeded the secondary water quality standard. Zinc exceeded the acute and chronic aquatic life criteria in the two upper samples. The third sample (BCCS20L) downstream from the second tailings impoundment had no exceedences. The pH in these samples did not show any discernable trend and the SC did not vary greatly. The TSS levels between the three samples did not show a marked increase. Further study would be needed to determine the suspected sediment load increase during storm events.

Table 10. Water-quality exceedences at the Carpenter Creek tailings.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BCCS10L-upstream on Carpenter Creek						AC							AC						
BCCS40H-downstream on Carpenter Creek				C		AC			S				AC						S*
BCCS20L-downstream from 2nd tailings																			

Exceedence codes:

- P - Primary MCL
- S - Secondary MCL
- A - Aquatic Life Acute
- C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix III

2.7.3.4 Vegetation

The tailings are nearly unvegetated. A few trees have established a foothold along Carpenter Creek, mainly spruce and a few willows. Interestingly, Equisetum (horsetails or scouring rush) grow abundantly at the toe of the tailings impoundment and, locally, on the surface of the tailings. This plant is known for its resilience to heavy metals; it was also noted at the Haystack Creek Iron Spring. Spruce and fir trees appeared to be healthy as they grew right up to the edge of the tailings impoundment.

2.7.3.5 Summary of Environmental Condition

The tailings added cadmium and manganese to Carpenter Creek, and there was a very slight increase in zinc values downstream.

2.7.4 Structures

Five cabins sit at the base of the upper tailings impoundment dam. Core from the Big Ben drilling project is stored in two of them as well as a few drilling supplies.

2.7.5 Safety

Some of the gullies are steep and pose a threat if ATV riders were to travel onto the tailings. No tracks were noted however. The faces on the edges of the tailings are also steep. The buildings are all in fair to good shape but some of the stacks of boxed core that are stored in them are not stable.

2.8 Summary of the Carpenter Creek Drainage

Most of the mine and mill sites exhibiting a potential to cause the greatest environmental problems on LCNF-administered land are in the Neihart mining district in the Carpenter Creek drainage which drains into Belt Creek. They are associated with the veins in the pre-Belt Pinto diorite, Snow Creek porphyry and other intrusives. The majority of the abandoned and inactive mining operations in the drainage that have the potential to affect water quality are on patented land and only three are on mixed private/public or all public land. Many of the private sites in the Neihart district were discharging water to nearby streams (faults were associated with many of the mines); several had waste material in contact with the stream. The relative severity of the impacts to LCNF-administered land in this area, however, was generally localized.

Repeated visits to some sites exemplify the need for multiple sampling events. For example, some mine sites had small discharges when Pioneer Technical Services studied them but did not have a discharge when MBMG visited them. Seasonal fluctuations, and annual differences in precipitation and runoff play a major role in the impacts of abandoned mining operations.

An accurate assessment of the cumulative impact of mining in this area on the drainage would require extensive sampling on private land. Only five samples were taken on Carpenter Creek itself. The Neihart area was also sampled at public access sites and mines were assessed as a group with relative results for an area. Table 17 lists the mines considered in this report. The exceedence of one or more MCLs is noted for each site as well as the analyses for each sample.

Table 11. Summary of water-quality exceedences in the Carpenter Creek drainage.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BCCS30L-upstream of mining activity																			S*
BXXS10M-upstream of mining on Mackay Creek																			
BXXS20M-Double X	S					AC			S				AC						
BHFS10H-Haystack Fe spring													AC						
BHCS10M-Haystack Creek upstream of mine																			
BHCS10M-Haystack Creek downstream of adit													AC						
BCCS20L-Carpenter Creek above tailings																			
BCCS40L-Carpenter Creek tailings				C		AC			S				AC						S*
BSNS10L-Snow Creek upstream from mining																			
BSNS20M-Snow Creek -Big Seven mine				C					S				AC						
BEES10M-upstream of Eight-eight mine						C			S				AC						
BEES20M -downstream of Eight-eight mine						C			S				AC						

Exceedence codes:

P - Primary MCL
S - Secondary MCL
A - Aquatic Life Acute
C - Aquatic Life Chronic

S* - Secondary MCL exceeded in field measurements, not in lab results.

Note: The analytical results are listed in appendix III.

Sites on Belt Creek were also sampled to assess the cumulative impacts of the mines in the Carpenter Creek drainage. A sample was taken upstream of all mining on Mackay, Carpenter and Belt creeks to determine the approximate water quality of the area unaffected by mining. Sites were sampled on Belt Creek both immediately upstream and downstream of the confluence with Carpenter Creek to assess the impact that Carpenter Creek has on Belt Creek. The most significant impacts appear to be the contribution of zinc (specifically by Carpenter Creek) and aluminum (by mining along both Carpenter and Belt creeks). Appendix III contains the analytical results and the total daily metals loading summary.

Table 12. Summary of water-quality exceedences in the Belt Creek drainage.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BBCS10M - upstream on Belt Creek																			
BBCS40L-Belt Creek upstream of Carpenter Creek	S																		
BBCS50L-downstream of Carpenter Creek	S												AC						

Exceedence codes:

P - Primary MCL
S - Secondary MCL
A - Aquatic Life Acute
C - Aquatic Life Chronic

Note: The analytical results are listed in appendix III.

Pollutants - Total Daily Load

The amount of metals that each site contributed to Carpenter Creek was calculated by multiplying the results of the chemical analyses by the discharge as it was influenced by mining sites. Appendix III shows the laboratory analyses and the calculated amount carried per day by the water at the time of sampling. Plate 4 shows the sample locations.

A comparison of the sample farthest upstream (upstream of all mining) and the sample the farthest downstream on Carpenter Creek reflects the total gain of metals due to all mining in the drainage. Aluminum, arsenic, barium, cadmium, iron, lead, mercury, and silver levels all either remained the same, or decreased in the downstream sample. Copper, manganese, nickel, and zinc all increased downstream. Zinc was the most appreciable increase; the total contribution of zinc from the headwaters (where the levels were <2) to downstream of the Eighty-Eight mine (where the levels are 529.2 μg/l) is 0.03 pounds per day. The sample was taken in May 1998 during relatively high water and snow melt. This is a rough estimate of the contribution at the conditions present at the time of sampling. The actual amount of metals' yearly total daily load may be somewhat different because of variations in streamflow. The levels would probably be lower at other times because the rest of the year, water flow is less and the amount of waste in contact with water is less.

Estimating the amount contributed by a single site is done by comparing analytical results of the upstream and downstream samples. The total amount contributes by an individual site would be the result of subtracting the upstream figure from the downstream result. In the case of the Carpenter Creek tailings, a slight increase in cadmium and manganese was observed, but a decrease in lead was measured with the other metals (including zinc) levels remaining approximately the same. Pioneer Technical Services (1995) reported an observed release (downstream samples were three times the concentration of the upstream samples) of arsenic, barium and lead from the Carpenter Creek tailings as measured in stream sediments.

Natural Pollutant Sources

No natural or non-human pollutant sources were identified in this area. The area has been so extensively mined since the late-1800s that the pre-mining condition of the creek is unknown. The upstream sample shows the presence of barium, chromium and iron, but this is also upstream from where the ore bodies are located. No copper, zinc, cadmium or lead were detected in the upstream sample. Other metals levels were at or below detection limits. No ferricrete deposits that would indicate prior surface expression of the metals (specifically iron) have been described in the area.

The Haystack Creek Iron Spring may be an indicator of some pre-existing natural contribution to the metals loading in the area. No other iron-rich springs were noted in the area, however, and this spring does not discharge water into an active stream channel.

Evaluation of the NPDES general permit process

The proposed NPDES general permit describes the process for federal managers to obtain coverage under the general permit for each land management area under their jurisdiction. In order to address the effectiveness and practical application of the permit process, the MBMG collected the preceding information for a permit application with the focus on Parts IV (watershed identification and ranking) and V (watershed characterization). This process is similar to the abandoned-inactive mines inventory and baseline sampling that has been conducted by the MBMG for both the USFS and the USBLM in Montana.

Overall, the process will provide the best means of collecting the necessary information to rank and prioritize abandoned-inactive mines in each watershed without exacting unnecessary time and expense. Alternative approaches such as air searches, literature searches, and restricting data collection to simple field parameters would likely produce poor results.

A more detailed evaluation of impacts of mining and milling waste on a watershed would require additional data pertaining to ground-water quality, and high-runoff versus low-flow events. These investigations are best implemented after the mines and the mills and their associated wastes are identified as outlined in the proposed permit.

The permit system fails to account for the impacts of private land (specifically patented mining claims) within the study area. As in the case of the Carpenter Creek drainage, private land can comprise the majority of an area that has had an extensive mining history. Private, patented land, in many instances, also hosts most of the mining development. In order to adequately characterize the drainage, it is necessary to sample on private land and private mining operations. This problem is addressed somewhat by sampling both upstream and downstream of the private holdings.

Other information required by the permit is vague and while seemingly straight-forward often requires assumptions on the part of the investigator. Natural pollutant sources are not specifically defined and no examples are given. Many of the historic mined areas were first mined in the late 1880s or 1890s so pre-existing conditions are unknown at the present time.

The 303(d) list is very general and may be used as a starting point for a ranking system but personal knowledge of Federal and state employees and field studies should be also used in ranking watersheds. Carpenter Creek received a low ranking as far as TMDL priority on the 1998 TMDL list. Common sense tells us that this drainage has been severely impacted by resource production (both mining and logging). An impartial ranking system has been previously used by the DSL-AMRB and MBMG, and was used in this study to rank mine sites within the Carpenter Creek drainage. This abandoned and inactive mines scoring system (AIMSS) is useful to rank the mine sites and has already been utilized by the DSL-AMRB for 331 mining sites in Montana. It was also used by MBMG staff to rank USFS and BLM sites.

Some of the required information was difficult to obtain. From talking with MDEQ personnel, the 303(d) list was the most comprehensive – more so than the 305(b) list and the 304(l) list. For this study, only the 303(d) list was used. Also, as a part of this study, the EPA reach numbers were not readily available so the USGS HUC numbers were used instead. Both of these numbers adequately designate the stream locations and so are probably interchangeable.

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Appendix I
Abandoned Mine Land Field Inventory Forms

APPENDIX A

ABANDONED MINE LAND
FIELD INVENTORY

·PECTED BY: J. LONN/P. HARGRAVE TITLE: GEOLOGIST DATE: 05-16-98 & 05-26-98
RGANIZATION: MBMG
HONE: 406-496 4177

IDENTIFICATION

. Site/Mine Name: HAYSTACK IRON SPRING

2. Agency Code: NF Site ID: CC008497 - (MBMG)

. USGS Quad: NEIHART LAT: 46° 58'32" LONG: 110°43'09"

UTM Coord (optional): — N — E Zone —

Township 14 N Range 08 E
Section 16 ¼ Section BDCC (optional)
. Environmental Conditions at time of Survey: SNOWMELT FLOW. —

NE WORKINGS

Feature # as pped	101	102	103	104	105	106	107	108	109	110
5. Type	AD									
Width, ft	—									
7. Height/Length ft	—									
8. Depth, ft	—									
Condition	FL									
10. Closure	—									
1. Closure Cond.	—									

NING WASTES N.A

Feature # as apped	201	202	203	204	205	206	207	208	209	210
12. Type										
3. Volume, cu. yds.										

... Water ...osion										
15. Flood ...one Loc.										
16. Wind ...rosion										
. Sulfides										
18. Vegetation										
.. Slope Stability										
. Closure										

THER DISTURBED AREAS N.A.

Feature # as Mapped	301	302	303	304	305	306	307	308	309	310
. Type										
22. Area, res										
23. Water osion										
24. Flood prone Loc.										
. Vegetation										

TER DISCHARGES

Feature # as Mapped	401	402	403	404	405	406	407	408
. Discharge From	SP							
27. Staining	Y							
. Aquatic Life	NO							
29. Distance to ceiving Water, ft	75'							
30. pH	6.85							
. Conductivity, µS	906							
32. Estimated Flow, gpm	4 gpm							

RECEIVING WATER

3. Type	PR
34. Name (if known)	HAYSTACK CREEK
5. Staining	NO
36. Off Site Sediment Transport	NO
7. Aquatic Life, upstream	Y
38. pH, upstream	—
9. Conductivity, µS, upstream	—
40. Aquatic Life, downstream	Y
1. pH, downstream	7.10
42. Conductivity, µS, downstream	135

. Type	
34. Name (if known)	
. Staining	
36. Off Site Sediment Transport	
. Aquatic Life, upstream	
38. pH, upstream	
. Estimated Flow, gpm	20 [illegible]

THER POLLUTION

N!.

Feature # as Mapped	501	502	503	504	505	506	507	508	509	510
. Type										

omments (Describe quantity, condition, location, and whether materials are fined by fencing, buildings, etc.):

TRUCTURES & EQUIPMENT

ature # as Mapped	601	602	603	604	605	606	607	608	609	610
. Type	BL									
46. Length,	—									
. Width, ft	–									
. Height,	—									
49. Condition	C									

RADIATION (complete only where appropriate)

50. Feature										
. Gamma, R/hr										
52. Alpha, WL										
3. Airflow direction										

HER SITE DATA

54. Commodities mined Zn Ag, Pb, A., Cu

In or near high value resource area (y/n) n Comments:

Cultural resource potential (y/n) N. On National Register of Historic Places (y/n/unk) N Comments:

Distance (mi) from: Nearest road <.1 Trail — Campground 2.75

Single Dwelling [illegible] School [illegible] Drinking Water Intake 2.75 Population Center 2.75

Access by: 2wd ✓ 4wd ____ Hike ____ Other ____ 4WD [illegible]

Road Log: DRIVE 2.6 [illegible] FROM [illegible] FT ON Hwy 89. [illegible] TRAVEL [illegible]

General slope of surrounding area (degrees): 0-10 ____ 11-35 ____ >35 ✓

APPENDIX A

ABANDONED MINE LAND
FIELD INVENTORY

: PECTED BY: P. HARGRAVE / M. KERSCHEN TITLE: GEOLOGIST DATE: 5/16/98 + 5/27/98
ORGANIZATION: MBMG.
HONE: 406-496-4606

E IDENTIFICATION

. Site/Mine Name: CARPENTER CREEK TAILINGS - UPPER IMPOUNDMENT

2. Agency Code: FS Site ID: CC008407 (MBMG)

. USGS Quad: NEIHART LAT: 48° 58' 00" LONG: 110° 43' 01"

UTM Coord (optional): ___ N ___ E Zone ___

. Township T. 14 N Range R 08 E.
Section 21 ¼ Section SE¼ SE¼ SW¼ (optional)

. Environmental Conditions at time of Survey: SNOWMELT FLOW.

MINE WORKINGS — TAILINGS ONLY.

Feature # as mapped	101	102	103	104	105	106	107	108	109	110
5. Type										
. Width, ft										
7. Height/Length ft										
8. Depth, ft										
. Condition										
10. Closure										
1. Closure Cond.										

NING WASTES

Feature # as mapped	201	202	203	204	205	206	207	208	209	210
12. Type	TL									
3. Volume, cu. yds.	50,000									

·'. Water osion	G - 30'x10'x200'										
15. Flood one Loc.	IC										
16. Wind Erosion	MO										
. Sulfides	P										
18. Vegetation	NO										
. Slope Stability	P										
. Closure	NO										

THER DISTURBED AREAS

Feature # as Mapped	301	302	303	304	305	306	307	308	309	310
.. Type	ED									
22. Area, :res	— 2.0 Acres									
23. Water :osion	G. 30'x10'x200'									
24. Flood prone Loc.	IC									
5. Vegetation	NO									

TER DISCHARGES None.

Feature # as Mapped	401	402	403	404	405	406	407	408
5. Discharge From	—							
27. Staining								
8. Aquatic Life								
29. Distance to eceiving Water, ft								
30. pH								
1. Conductivity, µS								
32. Estimated Flow, gpm								

RECEIVING WATER

3. Type	PR.
34. Name (if known)	CARPENTER CREEK
5. Staining	NO
36. Off Site Sediment Transport	YES
17. Aquatic Life, upstream	NO
38. pH, upstream	6.92
19. Conductivity, µS, upstream	30.2 umhos @ 25°C
40. Aquatic Life, downstream	NO
11. pH, downstream	6.39
42. Conductivity, µS, downstream	82.8 @ 25°C

. Type	PR
34. Name (if known)	CARPENTER CREEK
. Staining	NO
36. Off Site Sediment Transport	Y
. Aquatic Life, upstream	NO
38. pH, upstream	6.92
. Estimated Flow, gpm	3,500 gpm

THER POLLUTION

Feature # as Mapped	501	502	503	504	505	506	507	508	509	510
. Type	NO.									

Comments (Describe quantity, condition, location, and whether materials are fined by fencing, buildings, etc.): ——

STRUCTURES & EQUIPMENT

Feature # as Mapped	601	602	603	604	605	606	607	608	609	610
. Type	BL	BL	BL	BL						
46. Length, ft										
47. Width, ft										
48. Height, ft										
49. Condition	S	S	S	S						

RADIATION (complete only where appropriate) ——

50. Feature										
51. Gamma, R/hr										
52. Alpha, WL										
53. Airflow direction										

HER SITE DATA

54 Commodities mined Zn, Ag, Pb, Au, Cu

55. In or near high value resource area (y/n) N. Comments:

56 Cultural resource potential (y/n) N. On National Register of Historic Places (y/n/unk) N Comments:

57 Distance (mi) from: Nearest road <50' Trail — Campground 3 mi

Single Dwelling 2.5 miles School 3 miles Drinking Water Intake 2.5 miles Population Center 2.5 miles

Access by: 2wd ✓ 4wd ____ Hike ____ Other ____

Road Log: TURN NE UP CARPENTER CREEK OFF OF Hwy 89. (FOREST ROAD 3323) TRAVEL 2.4 MILES TO RIGHT HAND TURN OFF. CROSS BRIDGE & TAKE LEFT HAND ROAD (NORTH) TO ABANDONED BUILDINGS.

General slope of surrounding area (degrees): 0-10 ____ 11-35 ____ >35 ✓

BUT TAILINGS ARE IN THE VALLEY BOTTOM @ 0°-10° SLOPE.

APPENDIX A

ABANDONED MINE LAND
FIELD INVENTORY

PECTED BY: J. Lon[illegible] TITLE: Geologist DATE: 05-27-98
RGANIZATION: [illegible]
HONE: [illegible]

E IDENTIFICATION

. Site/Mine Name: Snow Creek Mill site

2. Agency Code: F.S. Site ID: CC008495 (MBMG)

. USGS Quad: NEIHART LAT: 46° 57' 29" LONG: 110° 42' 52"

UTM Coord (optional): — N — E Zone —

Township 14N Range 08E
Section 21 ¼ Section CADA (optional)

. Environmental Conditions at time of Survey: [illegible]

INE WORKINGS NA. — TAILINGS CAME FROM VARIOUS MILLS UP DRAINAGE

Feature # as apped	101	102	103	104	105	106	107	108	109	110
5. Type	—									
. Width, ft	—									
7. Height/Length ft										
8. Depth, ft										
. Condition										
10. Closure										
.1. Closure Cond.										

INING WASTES

Feature # as Mapped	201	202	203	204	205	206	207	208	209	210
12. Type	TL									
13. Volume, cu. yds.	<100									

. Water osion	NA.										
15. Flood one Loc.	OT										
16. Wind Erosion	LO										
. Sulfides	NO										
18. Vegetation	EQ										
. Slope Stability	S										
. Closure	NO										

THER DISTURBED AREAS

Feature # as Mapped	301	302	303	304	305	306	307	308	309	310
. Type										
. Area, res										
23. Water osion										
24. Flood prone Loc.										
. Vegetation										

TER DISCHARGES NA.

Feature # as Mapped	401	402	403	404	405	406	407	408
. Discharge From								
27. Staining								
. Aquatic Life								
29. Distance to eceiving Water, ft								
30. pH								
1. Conductivity, μS								
32. Estimated Flow, pm								

RECEIVING WATER

3. Type	PR
34. Name (if known)	SNOW CREEK
5. Staining	YES - ORANGE
36. Off Site Sediment Transport	YES
7. Aquatic Life, upstream	NO
38. pH, upstream	7.10
39. Conductivity, μS, upstream	468 μmhos @ 25°C
40. Aquatic Life, downstream	NO
41. pH, downstream	7.09
42. Conductivity, μS, downstream	150.5 μmhos @ 25°C

. Type	PK
34. Name (if known)	[illegible] CREEK
. Staining	YES
36. Off Site Sediment Transport	YES
. Aquatic Life, upstream	NO
38. pH, upstream	7.10
. Estimated Flow, gpm	100 GPM.

THER POLLUTION NA

:eature # as Mapped	501	502	503	504	505	506	507	508	509	510
. Type										

omments (Describe quantity, condition, location, and whether materials are fined by fencing, buildings, etc.):

RUCTURES & EQUIPMENT

ature # as Mapped	601	602	603	604	605	606	607	608	609	610
. Type	WS	BL								
46. Length,										
. Width, ft										
. Height,										
49. Condition	D	C								

RADIATION (complete only where appropriate)

50. Feature										
.. Gamma, R/hr										
52. Alpha, WL										
3. Airflow direction										

HER SITE DATA

54. Commodities mined Pb, Zn, Ag + Au + Cu.

In or near high value resource area (y/n) N. Comments:

Cultural resource potential (y/n) N On National Register of Historic Places (y/n/unk) N Comments:

Distance (mi) from: Nearest road 50' Trail — Campground 3 mi

Single Dwelling 1.75 School 1.85 Drinking Water Intake 1.75 Population Center 1.75

Access by: 2wd ✓ 4wd ___ Hike ___ Other ___

Road Log: [illegible] OFF OF HWY 89. [illegible] EAST [illegible] ROAD [illegible] SMALL [illegible] TO RIGHT (SOUTH), [illegible] FROM MAIN ROAD.

General slope of surrounding area (degrees): 0-10 ___ 11-35 ✓ >35 ___

APPENDIX A

ABANDONED MINE LAND
FIELD INVENTORY

SPECTED BY: J. L[illegible] TITLE: Geologist DATE: 05-17-98 & 05-27-98
ORGANIZATION: MBMG
PHONE: 406-496-4177

SITE IDENTIFICATION

1. Site/Mine Name: Snow Creek Adits — Lexington #2
2. Agency Code: NF Site ID: CC008527 (MBMG)
3. USGS Quad: NEIHART LAT: 46°57'34" LONG: 110°42'08"

UTM Coord (optional): — N — E Zone —

Township 14N Range [illegible]E
Section 22 ¼ Section CBFA (optional)

4. Environmental Conditions at time of Survey: [illegible] —

MINE WORKINGS

Feature # as Mapped	101	102	103	104	105	106	107	108	109	110
5. Type	AD	AD								
6. Width, ft	—	—								
7. Height/Length, ft	—	—								
8. Depth, ft	—	—								
9. Condition	FL	FL								
10. Closure	-Collap	sed —								
11. Closure Cond.	—	—								

MINING WASTES

NONE NOTED

Feature # as Mapped	201	202	203	204	205	206	207	208	209	210
12. Type										
13. Volume, cu. yds.										

14. Water Erosion										
15. Flood Zone Loc.										
16. Wind Erosion										
17. Sulfides										
18. Vegetation										
19. Slope Stability										
20. Closure										

THER DISTURBED AREAS

Feature # as Mapped	301	302	303	304	305	306	307	308	309	310
.. Type										
2. Area, cres										
23. Water rosion										
4. Flood prone Loc.										
5. Vegetation										

TER DISCHARGES SEEP ONLY

Feature # as Mapped	401	402	403	404	405	406	407	408
6. Discharge From	AD 101	—						
27. Staining	NO							
8. Aquatic Life	YES							
29. Distance to eceiving Water, ft	>25'							
30. pH	—							
1. Conductivity, μS	—							
32. Estimated Flow, gpm	<1	—						

ECEIVING WATER

33. Type	PERENNIAL
34. Name (if known)	SNOW CREEK
35. Staining	NO
36. Off Site Sediment Transport	NONE
37. Aquatic Life, upstream	YES
38. pH, upstream	—
39. Conductivity, μS, upstream	—
40. Aquatic Life, downstream	—
41. pH, downstream	—
42. Conductivity, μS, downstream	—

. Type	
34. Name (if known)	
. Staining	
36. Off Site Sediment Transport	
. Aquatic Life, upstream	
38. pH, upstream	
. Estimated Flow, gpm	

THER POLLUTION None

Feature # as Mapped	501	502	503	504	505	506	507	508	509	510
4. Type										

Comments (Describe quantity, condition, location, and whether materials are confined by fencing, buildings, etc.):

STRUCTURES & EQUIPMENT None

Feature # as Mapped	601	602	603	604	605	606	607	608	609	610
5. Type										
46. Length, ft										
47. Width, ft										
48. Height, ft										
49. Condition										

RADIATION (complete only where appropriate) NA.

50. Feature										
51. Gamma, R/hr										
52. Alpha, WL										
53. Airflow direction										

HER SITE DATA

54. Commodities mined Pb, Ag, Zn, ? Au + Cu

55. In or near high value resource area (y/n) n Comments:

Cultural resource potential (y/n) n On National Register of Historic Places (y/n/unk) N Comments:

Distance (mi) from: Nearest road <.1 Trail — Campground 4 (ASPEN)

Single Dwelling 2.25 School 7.30 Drinking Water Intake [illegible] Population Center 225 mi

Access by: 2wd ✓ 4wd ____ Hike ____ Other ____

Road Log: TAKE NATIONAL FOREST ROAD 3323 TO SEC 21, TURN LAST on [illegible] CREEK ROAD & TRAVEL 16 [illegible] TO S 1/2 SEC. 22 @ SWITCHBACK. TWO ADIT SYMBOLS ON MAP. GATE IS ~100 [illegible] ADITS.

General slope of surrounding area (degrees): 0-10 ____ 11-35 ____ >35 ✓

Appendix II
List of All Sites in the Lewis and Clark National Forest

Lewis and Clark National Forest							* - not yet evaluated	
MBMG ID	Owner	Site Name	Township	Range	Section	Tract	1:24k	VISIT
MR008498	N	ADIT IN SEC 25/9N/8E	09N	08E	25	DCBD	FOURMILE SPRING	Y
JB008506	N	ADIT IN SEC 29/14N/10E	14N	10E	29	CCCB	BANDBOX MOUNTAIN	Y
MR000253	P	ALABAMA-CLEVELAND MINE	08N	07E	03		MANGER PARK	N
CC002447	M	ALBRIGHT DEPOSIT	16N	06E	22		RICEVILLE	N
CC002933		ALBRIGHT GROUP /LAST CHANCE, VALLEY	15N	06E	13		THUNDER MOUNTAIN	*
MR003142	P	ALICE MINE	09N	08E	36	DCAC	CASTLE TOWN	Y
MR003727	N	AMERICAN	08N	08E	22		CASTLE TOWN	Y
JB005297	P	AMERICAN - KUNISAKI YOGO SAPPHIRE	13N	11E	21	CBCB	INDIAN HILL	N
MR008478	P	ANNIE MAUDE	09N	08E	36	DCAA	CASTLE TOWN	Y
MR003702	N	ANTELOPE	08N	08E	02	DDDB	CASTLE TOWN	Y
LC007362	N	BABE PROSPECT	18N	09W	13		JAKIE CREEK	N
JB005307	P	BELL MINES	15N	09E	18		BARKER	N
MR000355	M	BELLE-OF-THE-CASTLE	08N	08E	02	CAAD	CASTLE TOWN	Y
JB008429	P	BELT PATENT	15N	09E		ABCC	BARKER	N
JB005097	N	BEN FRANKLIN,SARSFIELD,SHERIDAN	14N	09E	36		YOGO PEAK	*
CC002897	P	BENTON MINE / REBELLION /SPOKANE	14N	08E	27	BCAD	NEIHART	Y
JB005117		BESSIE / SEIDEN	14N	10E	16		BANDBOX MOUNTAIN	*
MR003082	P	BIESEL MINE	10N	09E	29		CHECKERBOARD	N
CC002891	N	BIG BEN DEPOSITS	14N	08E	21	ABDB	NEIHART	Y
CC002885	P	BIG SEVEN	14N	08E	28	ADAA	NEIHART	Y
TE001004	N	BIGGS CREEK PROSPECTS	24N	09W	06		OUR LAKE	N
CC002729	P	BLACK DIAMOND	14N	08E	22	CCAC	NEIHART	Y
CC002879	P	BLACKBIRD / BLACK BIRD / MAUD S.	14N	08E	28	CCAC	NEIHART	Y
MR003547	P	BLACKHAWK-ALICE PROPERTY	09N	08E	36	DDAC	CASTLE TOWN	Y
JB004817	M	BLACKTAIL HILLS	15N	10E	12		WOLF BUTTE	N
JB005122	N	BLANKENSHIP	15N	09E	22		MIXES BALDY	*
CC002123		BLIZZARD	14N	08E	28		NEIHART	N
JB005047	P	BLOCK P MINE / GREY EAGLE	15N	09E	06	DCCD	BARKER	Y
CC008375	M	BLOCK 'P' TAILINGS	15N	08E	13		BARKER	Y
JB008505	N	BLUE DICK MILL	14N	10E	31	AADC	BANDBOX MOUNTAIN	Y
JB005077	N	BLUE DICK MINE	14N	10E	30	ABDB	BANDBOX MOUNTAIN	Y
CC002237		BOSS MINE	14N	08E	29		NEIHART	N
CC002591		BOSS MINE / ATLANTUS	14N	08E	28		NEIHART	N
JB005102	N	BOURKE-LARSON	13N	09E	02		YOGO PEAK	*
CC002249	P	BROADWATER = LIBERTY?	14N	08E	33	ADAA	NEIHART	Y
MR003412	P	BROADWAY	08N	08E	14	ADBA	CASTLE TOWN	Y
CC002585		BROKEN HILL	14N	08E	33		NEIHART	N
CC002693	P	BULL OF THE WOODS MINE	14N	08E	33	BCBB	NEIHART	Y
LC004259		BURRELL AND EVANS	19N	07W	29		STEAMBOAT MOUNTAIN	*
JB005107	N	CALIFORNIA (HARRIET)	14N	10E	30	ADDD	YOGO PEAK	Y
MR003522	P	CALIFORNIA / CALIFORNIA-HENDRICKS	08N	08E	01	CDDA	CASTLE TOWN	Y
MR003467	P	CALUMET-JAMISON AND HECLA	10N	09E	32		CHECKERBOARD	N
CC008407	M	CARPENTER CREEK TAILINGS	14N	08E	21	BAAB	NEIHART	Y
JB005132		CARTER	15N	09E	06		BARKER	N
MR003562		CASTLE LEAD	08N	08E	11		CASTLE TOWN	*
CC002573	P	CHAMPION "B"	14N	08E	29	ADDD	NEIHART	Y
LC004514	P	CHIEF OF THE MTNS. PATENTED CLAIM	21N	10W	01		PATRICKS BASIN	N
JB005127		CHRISTOPHER COLUMBUS	14N	10E	20		BANDBOX MOUNTAIN	*
LC001825	N	CINNAMON LODE	18N	09W	14		JAKIE CREEK	N
MR000343	N	CLARA BARTON / CLARA BURTON	10N	10E	22	BCDA	MOUNT HOWE	Y
MR008490	N	CLEOPATRA / FORGET-ME-NOT	08N	08E	12	BCAC	CASTLE TOWN	Y
CC002567	P	COMPROMISE CLAIM	14N	08E	32	ABCB	NEIHART	N
CC002561	P	CONCENTRATED AND MONARCH	14N	08E	29	CBDD	NEIHART	Y
MR008475	N	COOK'S FLAT MANGANESE	10N	10E	16	DDDA	MOUNT HOWE	Y
CC002135		COPES / AJAX 1 & 2/ LEADVILLE 1 & 2	14N	06E	09		BLANKENBAKER FLATS	*
MR000367	P	COPPER DUKE	10N	09E	29		FOURMILE SPRING	N
MR003567	M	COPPER STATE MINE	11N	08E	15	CDBB	VOLCANO BUTTE	*
MR000361	P	COPPEROPOLIS	10N	09E	29		CHECKERBOARD	N

CC002537	P	CORNUCOPIA MINE	14N	08E	22	DCCD	NEIHART	Y
CC002531	M	COWBOY	14N	08E	17	CCDD	NEIHART	Y
CC002525	P	CUMBERLAND	14N	08E	29	DCCB	NEIHART	Y
MR003572	M	CUMBERLAND MINE	08N	08E	14	DABB	CASTLE TOWN	Y
CC002837	P	DACOTAH MINE	14N	08E	28	BCDC	NEIHART	Y
JB008435	P	DANNY T	15N	09E	07	ACBC	BARKER	N
CC002483	P	DAWN AND FOSTER	14N	08E	16	AABB	NEIHART	Y
JB005347	N	DELLA AND QUAKER CITY	14N	10E	30	DACC	BANDBOX MOUNTAIN	Y
JB004772		DEWEY / IRON KING / IRON CLAD	15N	10E	32		WOLF BUTTE	•
LC001837	N	DEXTER LODE	20N	10W	16		WOOD LAKE	N
JB005137		DOCKTER KALLOCH	15N	09E	07		BARKER	N
CC002795	P	DOUBLE X (XX)	14N	08E	16	AACC	NEIHART	Y
CC008508	N	DRY FORK BELT CREEK LOWER TAILINGS	15N	08E	23	ACAB	BARKER	Y
MR003392		DUCOLIN-POTTER PROSPECT / DUCOLON	14N	04E	26		BALD HILLS	•
JB004692		EAGLE EYE CLAIM	13N	09E	01		YOGO PEAK	•
JB008432	P	EDWARDS	15N	09E	07	BABC	BARKER	N
CC002513	P	EIGHTY EIGHT / 88 / EIGHTY-EIGHT	14N	08E	20	CADB	NEIHART	Y
CC008414	P	EMMA	14N	08E	15	BBDC	NEIHART	Y
CC002555	P	EQUATOR MINE	14N	08E	29	CDAB	NEIHART	Y
MR003752	P	ETTA CLAIM	08N	08E	14	ACAB	CASTLE TOWN	Y
MR003577		EXCELSIOR	14N	06E	06		MONUMENT PEAK	•
CC002903	P	FAIRPLAY & BON TON	15N	08E	01	DDCA	BARKER	N
CC002543	P	FAIRPLAY MINE	14N	08E	28	CBAA	NEIHART	Y
MR003757	N	FELIX CEXENT / FELIX CREXENT	09N	08E	36	ADCC	CASTLE TOWN	Y
JB005037		FINLANDER	14N	09E	35		YOGO PEAK	•
CC002699	P	FLORENCE MINE	14N	08E	29	CCAA	NEIHART	Y
JB005357	P	FOREST	15N	09E	18		BARKER	Y
CC002501	P	FRISCO	14N	08E	29	BCDB	NEIHART	Y
JB004697		GALENA	14N	10E	31		YOGO PEAK	•
CC002495	P	GALT-QUEEN	14N	08E	29	CDCC	NEIHART	Y
CC002129		GAVANDER / GOLD BUG	14N	06E	06		BLANKENBAKER FLATS	•
JB005057		GLENDENNIN GROUP / CLENDENNIN	14N	09E	05		MIXES BALDY	•
LC004509	N	GOAT RIDGE PROSPECT	24N	11W	03		THREE SISTERS	N
JB005082	N	GOLDBUG / WEATHERWAX	14N	10E	29		BANDBOX MOUNTAIN	•
MR003742	P	GOLDEN EAGLE	08N	08E	02	ACAD	CASTLE TOWN	Y
CC002873	P	GRAHAM & HOLLOWBUSH / S & R	14N	08E	32	DDDB	NEIHART	Y
MR003487		GRASSHOPPER	09N	08E	19		PINCHOUT CREEK	•
MR003437	P	GREAT EASTERN & GREAT WESTERN	08N	08E	11	DABA	CASTLE TOWN	Y
MR008477		HAMILTON MINE	08N	08E	11	ACAC	CASTLE TOWN	Y
CC002255		HARNER & DAVIS PROSPECT	14N	08E	33		NEIHART	N
CC002867	P	HARTLEY	14N	08E	32	AABA	NEIHART	Y
CC002855	P	HATCHET	14N	08E	20	DBDB	NEIHART	Y
CC008507	P	HAYSTACK CREEK MINE	14N	08E	16	CACC	NEIHART	Y
CC008497	N	HAYSTACK IRON SPRING	14N	08E	16	BDCA	NEIHART	Y
CC002603	P	HEGENER GROUP / VILIPA	14N	08E	16	ACDC	NEIHART	Y
JB004652	N	HELL CREEK CLAIMS	13N	09E	18		YOGO PEAK	N
CC002597	M	HIDDEN TREASURE	14N	08E	32	AADC	NEIHART	Y
MR003407	P	HIDDEN TREASURE CLAIM	08N	08E	12	BBAD	CASTLE TOWN	Y
JB004707	N	HILL SIDE NO. 3 CLAIM	13N	09E	12		YOGO PEAK	•
MR003557	P	HOMESTAKE MINE	08N	08E	12	ACCC	CASTLE TOWN	Y
CC002195	N	HOOVER CREEK QUARRY	15N	08E	31		MONARCH	N
CC002909		HURRICANE AND TORNADO / EDNA	15N	06E	13		THUNDER MOUNTAIN	•
CC002861	P	INGERSOLL	14N	08E	29	DACA	NEIHART	Y
JB004657	N	IRON CAP CLAIM	13N	09E	03	CBCD	YOGO PEAK	•
MR003492	P	IRON CHIEF	08N	08E	01	CDAB	CASTLE TOWN	Y
MR003537	M	IRON CLIFF	12N	06E	34		STRAWBERRY BUTTE	N
MR008376	N	IRON MINES PARK	14N	06E	24		BUBBLING SPRINGS	•
MR002519	N	IRON MOUNTAIN	14N	06E	13		BUBBLING SPRINGS	•
JB004672	N	IRON ORE DEPOSITS NEAR YOGO PEAK	14N	10E	30		BANDBOX MOUNTAIN	N
JB004627	M	IROQUOIS PROSPECT	15N	11E	32		CAYUSE BASIN	N
CC002921	P	IXL / I.X.L. / EUREKA	14N	08E	29	AABD	NEIHART	N
JB005252	P	J.W. SISSON GYPSUM DEPOSIT	16N	10E	21	CBBC	WOLF BUTTE NW	N

LC001735		JESSIE PROSPECT	18N	09W	04		SCAPEGOAT MOUNTAIN	*
LC001891		JEWEL MOUNTAIN MINING CO.	18N	09W	28		SCAPEGOAT MOUNTAIN	*
CC002111	P	JOHANNESBURG	14N	07E	12	DDAD	BELT PARK BUTTE	N
MR003552	P	JUDGE MINE	09N	08E	36	DAAB	CASTLE TOWN	Y
MR003582	P	JUMBO MINE	08N	08E	14	ADDA	CASTLE TOWN	Y
MR008476	N	KID'S DREAM PROSPECT	10N	10E	15	BCAA	RUSSIAN FLAT	Y
JB004637	M	KING CREEK MINES	14N	11E	27		WOODHURST MOUNTAIN	N
MR003427		KING GROUP	14N	04E	26		BALD HILLS	*
JB004632		KOLAR BENTONITE	14N	11E	27		WOODHURST MOUNTAIN	N
MR003712	P	LEGAL TENDER	09N	08E	36	ACCA	CASTLE TOWN	Y
JB004822	N	LEONARD	13N	09E	03		YOGO PEAK	*
JB005362		LEONARD II	13N	09E	04		YOGO PEAK	*
CC002117	P	LEROY (SEE ALSO JOHANNESBURG)	14N	07E	12	DDAD	BELT PARK BUTTE	N
CC002717	P	LEXINGTON / UNION/ MOUNTAIN VIEW	14N	08E	28	ACDB	NEIHART	Y
JB005062	P	LIBERTY MINE / OWNER FAITH MINING	15N	09E	07		BARKER	N
MR003102	N	LITTLE BELT MINE	10N	10E	32	AACC	MOUNT HOWE	Y
JB005302		LITTLE EMMA	14N	09E	36		YOGO PEAK	*
CC008494	P	LIZZIE	14N	08E	29	DABA	NEIHART	Y
CC002927	P	LONDON	14N	08E	29	CBBB	NEIHART	N
JB004717		LONE STAR	13N	09E	32		SAND POINT	*
MR008474	N	LUCKY BOY	10N	10E	11	CACD	RUSSIAN FLAT	Y
MR003432	N	LUCKY DOLLAR MINE / SILVER SPOON	08N	08E	12	ADDD	CASTLE TOWN	Y
CC002849	P	LUCKY STRIKE / COMMONWEALTH /	14N	08E	28	BDAC	NEIHART	Y
CC008496	P	LUCY CREEK	14N	08E	17	DDDA	NEIHART	Y
MR003107	M	LYNN MINE / HIGH TARIFF	11N	07E	10	ACAD	CHARCOAL GULCH	*
LC004214		MAGMA	18N	06W	30		BEAN LAKE	*
JB005367	P	MAGNOLIA & ST. LOUIS	15N	09E	07	DBDC	BARKER	N
MR003502	P	MANGER MANGANESE	14N	03E	09		MANGER PARK	N
JB008428	P	MARCELLINE	15N	09E	07	BDBA	BARKER	N
JB005372	P	MAY & EDNA	15N	09E	06		BARKER	Y
MR003112	M	MAYBE MINE	11N	08E	15		VOLCANO BUTTE	N
MR003717	P	MERRIMAC / MERRIMAC #1	08N	08E	14	ABDA	CASTLE TOWN	Y
JB005287	M	MIDDLE FORK / DRY FORK BELT CREEK	14N	09E	06		BARKER/MIXES BALDY	N
MR003732	N	MILWAUKEE MINE	08N	08E	02	DABB	CASTLE TOWN	Y
CC002939	M	MINUTE MAN - LAST HOPE - WESTGARD	14N	08E	15	CCBA	NEIHART	Y
CC002843	P	MOGUL LODE MINE	14N	08E	32	CACD	NEIHART	Y
MR000331	N	MONTANA COPPER / BARNETTE	09N	10E	33	CAAB	GROVELAND	Y
MR003442	M	MONTCANA GROUP	08N	08E	02		CASTLE TOWN	N
CC002723	P	MORNING STAR MINE	14N	08E	29	CBBC	NEIHART	Y
CC002681	P	MOULTON / MOLTON GROUP/COMPROMISE	14N	08E	29	DBCA	NEIHART	Y
CC002951	P	MOUNTAIN CHIEF	14N	08E	20	CDDC	NEIHART	Y
JB005377		MOUNTAINSIDE AND LAST CHANCE	14N	10E	16		BANDBOX MOUNTAIN	*
JB004792	N	NANCY LOU MINE	14N	09E	36		YOGO PEAK	*
JB008430	P	NE SE S7 (LUCKY STRIKE)	15N	09E	07	CAAD	BARKER	N
CC008410	P	NEIHART TAILINGS	14N	08E	29	CCB	NEIHART	Y
CC002957	P	NEVADA	14N	08E	29	CADD	NEIHART	Y
CC002963		NEW ALICIA & NEW RODWELL CLAIMS	14N	08E	10		NEIHART	N
JB005092		NEW DEAL	14N	10E	30		BANDBOX MOUNTAIN	Y
MR000337	N	NEW DEAL & JUMBO MINES / BOSS	10N	10E	12	BCDC	RUSSIAN FLAT	N
JB004642		NEW MINE SAPPHIRE SYNDICATE MINE	13N	11E	23		WOODHURST MOUNTAIN	N
MR008503	N	NF SITE ON HENSLEY CREEK	08N	08E	11	AABD	CASTLE TOWN	Y
CC002969		NILSON	14N	06E	10		THUNDER MOUNTAIN	*
JB004667	N	OLD MACK	13N	09E	03		YOGO PEAK	*
JB004712		OLE GRENDAL ET	13N	09E	32		SAND POINT	*
MR008504	N	OPEN CUT SEC 33/9N/10E	09N	10E	33	ACAB	MOUNT HOWE	Y
JB005382	N	OSCAR HELSING	14N	10E	16		BANDBOX MOUNTAIN	*
JB004722		OUR ONLY CHANCE	12N	09E	04		SAND POINT	*
JB004702	N	OVERLOOK CLAIM	14N	10E	32	CBCB	BANDBOX MOUNTAIN	Y
CC002915	M	PALMETTO NO. 2	15N	06E	34		THUNDER MOUNTAIN	N
JB005387		PARAGON	15N	09E	06		BARKER	Y
MR003532		PARNELL-BOARD-OF-TRADE	14N	06E	31		MONUMENT PEAK	*
CC002813		PEABODY	14N	08E	29		NEIHART	N

JB005392		PIERCE-HIGBEE / DRY WOLF	14N	10E	18		YOGO PEAK	•
JB005292		PIG EYE BASIN GYPSUM	14N	11E	34		WOODHURST MOUNTAIN	N
MR003122	N	PLACER CREEK	14N	06E	17		BUBBLING SPRINGS	N
MR003117	N	PLACER CREEK DEPOSIT	14N	06E	08		BUBBLING SPRINGS	N
CC002705		PONDEROSA MINE	14N	08E	15		NEIHART	N
MR003762	N	POWDERLY (SILVER DOLLAR)	08N	08E	12	ADDD	CASTLE TOWN	Y
CC002165	P	PRIDE OF THE WEST	15N	08E	12		BARKER	N
MR003737		PRINCESS	08N	08E	28		CASTLE TOWN	Y
MR008502	P	PRIVATE SITE WITH STREAM CUT DUMP	08N	08E	02	DDCB	CASTLE TOWN	Y
CC008486	N	PROSPECT - SEC 23	16N	06E	23	DADD	RICEVILLE	Y
MR008485	N	PROSPECTS IN SEC 05	14N	05E	05	ACDB	BLANKENBAKER FLATS	•
MR008481	N	PROSPECTS IN SEC 36/9N/8E	09N	08E	36	AACC	FOURMILE SPRING	Y
MR008493	M	PROSPECTS IN SEC 6/8N/9E	08N	09E	06	ABBB	CASTLE TOWN	Y
MR008501	N	PROSPECTS NE OF HIDDEN TREASURE	08N	08E	01	CDCC	CASTLE TOWN	Y
MR008500	N	PROSPECTS SEC 02/8N/8E	08N	08E	02	BBDC	CASTLE TOWN	Y
JB005402	P	QUEEN ESTHER	15N	09E	06		BARKER	N
CC002819	P	QUEEN OF THE HILLS	14N	08E	29	CDCA	NEIHART	Y
MR003722	N	QUEEN-HENSLEY GROUP / COPPER BOWL /	08N	08E	02	ACCC	CASTLE TOWN	Y
LC001747		READY MONEY MINE	18N	08W	03		STEAMBOAT MOUNTAIN	•
MR003512		RINGLING MINE / WILLOW CREEK IRON	09N	07E	26		PINCHOUT CREEK	•
CC002807	P	RIPPLE	14N	08E	27	CBBB	NEIHART	Y
CC002801	P	ROCHESTER AND UNITY	14N	08E	29	DDBD	NEIHART	N
LC001603	N	ROOSEVELT CLAIM	18N	09W	03		JAKIE CREEK	N
JB004687	M	RUBY / SNOWBALL / YELLOWBELL	14N	09E	36		YOGO PEAK	N
JB005442		RUNNING WOLF IRON DEPOSITS	14N	11E	07		BANDBOX MOUNTAIN	•
CC002297	P	RUTH MARY AND FITZPATRICK	13N	08E	04	ACAA	NEIHART	Y
JB005257		SAGE CREEK IRON DEPOSIT	14N	11E	22		WOODHURST MOUNTAIN	•
JB005067	N	SAN MARCOS / MONTGOMERY	15N	09E	31		BARKER	•
CC002777	P	SAVAGE	14N	08E	15	BACC	NEIHART	Y
MR008461	N	SEC 11 PROSPECTS	11N	07E	11	DBCB	CHARCOAL GULCH	•
MR008479	N	SEC 12 PROSPECTS	11N	07E	12	CDBB	CHARCOAL GULCH	•
JB005072		SETTER MINE / HANS SETTER	14N	10E	21		BANDBOX MOUNTAIN	•
MR008484	N	SHAFT - SEC 18	11N	08E	18	ABCC	CHARCOAL GULCH	•
MR008480	N	SHAFT IN SEC 07/9N/9E	09N	09E	07	DBCD	FOURMILE SPRING	Y
MR008491	N	SHAFT IN SEC 11/8N/8E	08N	08E	11	ABBC	CASTLE TOWN	Y
MR008492	N	SHAFT SEC 02/8N/8E	08N	08E	02	CACC	CASTLE TOWN	Y
MR008499	N	SHAFT SEC 35/9N/8E	09N	08E	35	CCCB	CASTLE TOWN	Y
MR003037		SHEEP CREEK DEPOSIT	12N	06E	11		STRAWBERRY BUTTE	•
CC002765	P	SHERMAN	14N	08E	15	CBAB	NEIHART	Y
JB005272		SILVER	15N	09E	07		BARKER	N
CC002753	P	SILVER BELL	15N	08E	13	ADAA	BARKER	N
CC002741	P	SILVER BELT	14N	08E	28	CBAD	NEIHART	Y
CC008412	P	SILVER DYKE MILL	14N	08E	15	BACC	NEIHART	Y
CC002711	P	SILVER DYKE MINE	14N	08E	10	CDDB	NEIHART	Y
CC008411	P	SILVER DYKE TAILINGS	14N	08E	15	BDCD	NEIHART	Y
JB005407	P	SILVER GULCH	15N	09E	06		BARKER	N
CC002453	P	SILVER HORN	14N	10E	28		NEIHART	N
MR003542	N	SILVER SPOON (SEE POWDERLY)	08N	08E	12	ADDD	CASTLE TOWN	Y
MR003417	P	SILVER STAR	08N	08E	12	DABC	CASTLE TOWN	Y
JB005412		SIR WALTER SCOTT & MYSTERY	14N	10E	10		BANDBOX MOUNTAIN	•
MR003697		SKIDOO	08N	08E	11		CASTLE TOWN	•
JB004802	N	SKUNK CREEK DEPOSIT	14N	10E	29		BANDBOX MOUNTAIN	N
CC008495	N	SNOW CREEK MILL	14N	08E	21	CADA	NEIHART	Y
MR003402	P	SOLID SILVER	08N	08E	12	BBCD	CASTLE TOWN	Y
JB004762	N	SOUTH FORK PLACER	11N	11E	05		DAISY PEAK	N
CC002669		SPOOFER MINE	15N	08E	24		BARKER	N
CC002735	N	SPOTTED HORSE	14N	08E	27	CADB	NEIHART	N
MR002977	M	SPRING CREEK	09N	10E	10		MOUNT HOWE	N
CC002471	M	SUNSHINE MINE	15N	08E	16		BARKER	N
JB005417	N	SWEEPSTAKES	12N	09E	23	DDDA	SAND POINT	•
JB005247		T.C. POWER	14N	10E	32		BANDBOX MOUNTAIN	•
CC002579	N	THORSON HOOVER CREEK	14N	08E	11		NEIHART	N

JB005422		TIGER MOULTON AND T.W. / HARRISON	15N	09E	05		MIXES BALDY	•
JB005427	P	TOP HAND	15N	09E	06		BARKER	N
MR000349	M	TOP LODE / TIP TOP / COPPER TOP	08N	08E	02		CASTLE TOWN	N
MR003517	P	TWENTIETH CENTURY CLAIM	14N	07E	19		BUBBLING SPRINGS	•
JB005342	P	UNNAMED GYPSUM	15N	10E	25		WOLF BUTTE	N
JB004752	P	UNNAMED GYPSUM OCCURRENCE	16N	08E	20		LIMESTONE BUTTE	N
MR003747	M	UNNAMED PUMICE	09N	08E	16		FOURMILE SPRING	N
CC002183	N	UNNAMED QUARRY	13N	08E	10	AACB	NEIHART	N
CC002231	N	UNNAMED QUARRY	15N	07E	24		MONARCH	N
JB004682		VANCOR GROUP	14N	09E	35		YOGO PEAK	•
MR003482	N	VANDOR / RUBY ADIT	08N	08E	02	ACDD	CASTLE TOWN	Y
CC002507		VENUS	14N	08E	21		NEIHART	N
MR003447	M	VOSS MINE	08N	08E	02		CASTLE TOWN	N
JB005112		WEATHERWAX AND KING CLAIMS	13N	09E	31		SAND POINT	•
CC002747	M	WHIPPOORWILL MINE / BLOTTER CLAIM	14N	08E	16	AAAC	NEIHART	Y
MR008482	N	WHITETAIL ADIT	10N	10E	16	DDAA	MOUNT HOWE	Y
MR003137	P	WHITTAKER 1901 CLAIM	14N	07E	19		BUBBLING SPRINGS	•
JB005267	M	WHITTAKER RIDGE	14N	10E	02		WOLF BUTTE	•
JB005262		WILLOW CREEK DEPOSIT	14N	11E	07		WOODHURST MTN	•
JB004807	P	WOLF BUTTE DEPOSIT	16N	10E	21		WOLF BUTTE NW	N
JB005432		WOODHURST & MORTSON	14N	10E	15		BANDBOX MOUNTAIN	•
JB008431	P	WRIGHT LODE	15N	09E	6	CCDA	BARKER	N
JB005437		YANKEE GIRL	14N	10E	14		BANDBOX MOUNTIAN	•
MR003587	P	YELLOWSTONE MINE	08N	08E	11	ABDD	CASTLE TOWN	Y
MR003387	N	YELLOWSTONE MINE	08N	08E	18		MANGER PARK	•
JB004787	M	YOGO CREEK PLACER	13N	10E	04		BANDBOX MOUNTAIN	Y

Appendix III
Water Analytical Results
Carpenter Creek Drainage - Lewis and Clark National Forest
and
Total Daily Load Results

Appendix III. Analytical results and exceedences of water analysis

µg/l = micrograms/liter; mg/l = milligrams/liter: < = below method detection limit; P = primary drinking water standard exceeded

S = secondary drinking water standard exceeded; A = acute aquatic standard exceeded; C = chronic aquatic standard exceeded

SC = specific conductance in micromhos/centimeter; Temp. = temperature in degree Celcius; GPM = gallons/minute; CFS = cubic feet/second

ID	Sample	Date	Al µg/l	As µg/l	Ba µg/l	Cd µg/l	Cr µg/l	Cu µg/l	Fe mg/l	Pb µg/l	Mn mg/l	Hg µg/l	Ni µg/l	Ag µg/l	Zn µg/l	-Cl mg/l	F mg/l	NO_3 as N mg/l	SO_4 mg/l	SiO_2 mg/l	TSS mg/l	Field pH	Field SC µmhos	Temp. °C	Lab SC µmhos	Lab pH	Flow Rate	Units
Neihart/Montana District																												
Carpenter Creek -upstream	BCCS30L	5/26/98	<15	<1	26.20	<2	<2	<2	0.011	<2	<.001	<1	<2	<1	9.7	<.5	<.05	<.05	4.3	7.8	<1.0	6.44 S	60.1	7.5	63.1	7.15	3.8	CFS
Double X - upstream	BXXS10M	5/27/98	<15	<1	32.10	<2	<2	3.60	0.020	<2	<.001	<1	<2	<1	99.2	<.5	0.119	<.05	28.5	19.1	<.05	7.34	113.2	5.3	122.4	7.10	5.0	GPM
Double X - downstream	BXXS20M	5/26/98	52.6 S	<1	56.10	<2	<2	59.40 A C	0.049	<2	0.080 S	<1	3.80	<1	332.0 A C	0.524	0.265	<.05	50.5	20.9	2.0	6.48	149.6	12.4	157.9	7.02	0.2	CFS
Haystack Iron Spring	BHFS10H	5/26/98	<30	3.30	9.80	<2	3.60	<2	5.812	<2	0.769	<1	21.30	<1	282.6 A C	0.781	3.090	<.05	434.0	28.4	9.0	6.85	906.0	7.1	903.0	6.86	4.0	GPM
Haystack Creek - upstream	BHCS10M	5/26/98	<15	<1	29.90	<2	<2	7.70	0.036	<2	0.021	<1	2.10	<1	62.3	<.5	0.307	<.05	48.8	24.8	<1.0	7.10	135.0	11.8	145.5	6.88	20.0	GPM
Haystack Creek - downstream	BHCS20M	5/26/98	<15	<2	23.10	<2	<2	6.20	0.007	<2	<.001	<1	2.40	<1	196.6 A C	<.5	0.326	<.05	50.0	23.9	17.0	6.86	133.2	10.4	139.0	6.78	0.2	CFS
Snow Creek - upstream	BSNS10L	5/27/98	<15	<1	16.01	<2	<2	<2	<.005	<2	<.001	<1	<2	<1	8.4	<.5	<.05	<.05	3.8	6.3	<1.0	7.10	46.8	5.3	53.5	7.06	2.1	CFS
Snow Creek - downstream	BSNS20M	5/27/98	<15	<1	24.79	2.70 C	<2	<2	0.097	<2	0.179 S	<1	8.60	<1	1050.0 A C	<.5	0.074	<.05	58.0	8.7	<1.0	7.09	150.5	7.1	172.4	6.80	5.6	CFS
Carpenter Creek - upstream of tailings	BCCS10L	5/26/98	<15	<1	26.70	<2	<2	30.20 A C	<.005	3.00	0.048	<1	<2	<1	353.3 A C	<.5	<.05	<.05	12.1	8.7	<1.0	6.92	30.2	11.1	86.7	7.00	8.6	CFS
Carpenter Creek - downstream tailings	BCCS20L	5/27/98	<15	<1	41.30	<2	28.30	<1	0.006	<2	0.047	<1	<2	<1	<5	<.5	<.05	<.05	16.9	9.4	2.0	7.51	95.2	10.9	93.8	6.87	6.3	CFS
Carpenter Creek - between ponds	BCCS40L	5/27/98	<15	<1	34.90	2.10 C	<2	30.40 A C	<.005	<2	0.071 S	<1	<2	<1	384.5 A C	<.5	0.054	<.05	14.9	9.2	<1.0	6.30 S	82.8	6.5	86.6	7.00	7.8	CFS
Carpenter Creek - upstream of Eighty-Eight	BEES10M	5/27/98	<15	<1	23.50	<2	<2	16.70 C	0.009	<2	0.069 S	<1	4.02	<1	537.0 A C	<.5	0.067	<.05	33.0	9.2	<1.0	7.58	114.1	9.3	118.2	6.98	12.3	CFS
Carpenter Creek - downstream of Eighty-Eight	BEES20M	5/27/98	<15	<1	30.67	<2	<2	16.10 C	0.008	<2	0.062 S	<1	3.80	<1	529.2 A C	<.5	0.069	<.05	32.4	9.2	<1.0	7.62	113.7	9.7	125.0	6.73	11.1	CFS
Belt Creek - upstream of all	BBCS10M	5/28/98	<15	<1	96.70	<2	2.50	<2	0.012	<2	<.001	<1	<2	<1	<2	0.639	<.05	<.05	4.1	6.8		7.25	101.5	3.1	122.5	7.45	40.9	CFS
Belt Creek - upstream of Carpenter	BBCS40L	5/28/98	52.6 S	<1	91.10	<2	2.30	<2	0.047	<2	0.025	<1	<2	<1	70.7	0.693	<.05	<.05	5.2	6.6	<1.0	7.75	93.9	4.6	107.4	7.46	48.6	CFS
Belt Creek - downstream of Carpenter	BBCS50L	5/28/98	63.9 S	<1	72.90	<2	<2	<2	0.032	<2	0.026	<1	<2	<1	124.7 A C	0.584	<.05	<.05	7.9	7.3	4.0	7.74	82.9	5.3	97.6	7.10	42.0	CFS

PENDIX III. Total daily loadings for samples in the Carpenter Creek and Belt Creek drainages.

Metals measured in UG/L (micrograms/liter) or in MG/L (milligrams/liter).

< = below detection limit.

		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		MG/L		UG/L		MG/L		UG/L		UG/L		UG/L		UG/L				
		Al	Al #/day	As	As #/day	Ba	Ba #/day	Cd	#/day Cd	Cr	#/day Cr	Cu	#/day Cu	Fe	#/day Fe	Pb	#/day Pb	Mn	#/DAY Mn	Hg	#/day Hg	Ni	#/day Ni	Ag	#/day Ag	Zn	#/day Zn	CFS		GPD
																														1440.0
CS30L	CARPENTER CREEK UPSTREAM OF ALL MIN	<15.		<1.		26.2	5.37E-04	<2.		<2.		<2.		0.011	0.0002255	<2.		<.001		<1.		<2.		<1.		9.66	1.98E-04	3.8	cfs	2456003.2
CS10M	BELT CR UPST NEIHART DISTRICT	<15.		<1.		98.7	2.18E-02	<2.		2.5	5.52E-04	<2.		0.012	0.0026498	<2.		<.001		<1.		<2.		<1.		<2.		40.94	cfs	26460203.2
CS40L	BELT CR UPST CARPENTER CR	52.6	1.38E-02	<1.		91.1	2.39E-02	<2.		2.3	6.03E-04	<2.		0.047	0.0123252	<2.		0.025	6.56E-03	<1.		<2.		<1.		70.7	1.85E-02	48.62	cfs	31423915.[illegible]
XS10M	DOUBLE X (XX) MINE • UPST ON MACKAY C	<15.		<1.		32.1	3.86E-05	<2.		<2.		3.6	4.33E-06	0.02	2.406E-05	<2.		<.001		<1.		<2.		<1.		99.2	1.19E-04	0.223	CFS	14412[illegible].6
XS20M	DOUBLE X (XX) MINE • DNST ON MACKAY C	52.6	5.67E-05	<1.		56.1	6.05E-05	<2.		<2.		59.4	6.41E-05	0.049	5.286E-05	<2.		0.08	8.63E-05	<1.		3.8	4.10E-06	<1.		332	3.58E-04	0.2	cfs	1292[illegible]3.3
CS40L	CARPENTER CR DNST TAILINGS	<15.		<1.		34.9	1.47E-03	2.1	8.82E-05	<2.		30.4	1.28E-03	<.005		<2.		0.071	2.98E-03	<1.		<2.		<1.		384.5	1.62E-02	7.79	cfs	5034[illegible]06.6
NS10L	SNOW CR • UPSTREAM	<15.		<1.		16	1.80E-04	<2.		<2.		<2.		<.005		<2.		<.001		<1.		<2.		<1.		8.4	9.42E-05	2.08	cfs	1344338.6
NS20M	SNOW CR • DOWNSTREAM	<15.		<1.		24.8	7.45E-04	2.7	8.11E-05	<2.		<2.		0.097	0.0029139	<2.		0.179	5.38E-03	<1.		8.6	2.58E-04	<1.		1050	3.15E-02	5.58	cfs	3599769.6
CS10L	CARPENTER CR DNST OF MACKAY CR	<15.		<1.		26.7	1.24E-03	<2.		<2.		30.2	1.41E-03	<.005		3	1.40E-04	0.048	2.23E-03	<1.		<2.		<1.		353.3	1.64E-02	8.63	cfs	5577712.6
CS20L	CARPENTER CR DNST SEC 16 TAILINGS	<15.		<1.		41.3	1.40E-03	<2.		28	9.57E-04	<1.		0.006	0.0002029	<2.		0.047	1.59E-03	<50.		<2.		<1.		<5.		6.27	cfs	4052405.3
HFS10H	HAYSTACK IRON SPRING	<30.		3.3	1.6E-07	9.8	4.70E-07	<2.		3.6	1.73E-07	<2.		5.812	0.000279	<2.		0.769	3.69E-05	<1.		21.3	1.02E-06	<1.		282.6	1.36E-05	0.009	cfs	5752.2
HCS10M	HAYSTACK CR DOWN FROM IRON SPRING	<15.		<1.		29.9	2.58E-05	<2.		<2.		7.7	6.64E-06	0.036	3.107E-05	<2.		0.021	1.81E-05	<1.		2.1	1.81E-06	<1.		62.3	5.38E-05	0.16	cfs	103410.7
HCS20M	HAYSTACK CR DOWN FROM PRIVATE ADIT	<15.		<1.		23.1	2.24E-05	<2.		<2.		6.2	6.02E-06	0.007	6.796E-06	<2.		<.001		<1.		2.4	2.33E-06	<1.		196.6	1.91E-04	0.18	cfs	116337.0
EES10M	CARPENTER CR UPSTREAM 88 MINE	<15.		<1.		23.5	1.56E-03	<2.		<2.		16.7	1.11E-03	0.009	0.0005966	<2.		0.069	4.57E-03	<1.		4.02	2.66E-04	<1.		537	3.56E-02	12.29	cfs	7943231.5
EES20M	CARPENTER CR DOWNSTREAM 88 MINE	<15.		<1.		30.7	1.84E-03	<2.		<2.		16.1	9.66E-04	0.008	0.0004798	<2.		0.062	3.72E-03	<1.		3.8	2.28E-04	<1.		529.2	3.17E-02	11.12	cfs	7187041.0
BCS50L	BELT CR BELOW CARPENTER CR RD	63.9	1.95E-02	<1.		72.9	2.23E-02	<2.		<2.		<2.		0.032	0.0096502	<2.		0.026	7.94E-03	<1.		<2.		<1.		124.7	3.81E-02	56.62	cfs	36594448.2